The City of Newcastle

Policy

Newcastle Airshed Management Action Plan

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Executive Summary

Like many cities reliant upon industry for employment and coal as a source of energy, Newcastle has had a history of poor air quality. In 1947 Newcastle City Council (NCC) established a Smoke Abatement Advisory Panel to reduce the impact of industrial emissions on air quality. This Panel continued in its role of reducing particulate pollution and sulphur dioxide emissions to the atmosphere up until 1984. In 1994, NCC completed the Newcastle Environmental Management Plan (NEMP). One of the key actions of the NEMP was to develop an airshed management plan for the city. A working group was formed in 1997 with membership from Council, regulatory agencies, technical experts, industry and community to develop a plan. Subsequently in 1998, the Newcastle Airshed Management Action Plan (NAMAP) was adopted to improve the air quality of the local and regional airsheds.

The NAMAP 1998 contained 11 key issues each of which had a framework for action containing specific objectives, target pollutants and responsibilities. Implementation of the actions contained in NAMAP 1998 was recently evaluated at about 50% with a greater implementation level for those actions where NCC had direct responsibility (See appendix 2).

The history of air quality as evidenced in monitoring results shows a substantial improvement in Newcastle's air quality over the period of monitoring by NCC (1951 to present), specifically in the area of fine particulate pollution. Since the closure of BHP steelworks in September 1999 there has been around a 30% reduction in the level of fine particulate matter monitored at NCC's monitoring stations at Mayfield and Stockton. Air quality monitoring conducted throughout the city shows that Newcastle is now achieving compliance with the National Environment Protection Measure (Ambient Air Quality) goals for all air pollutants monitored (See Section 5). Although these goals are achieved, there are occasions when air pollutants approach levels that may affect the health of some residents of Newcastle. An increasing number of motor vehicles registered in Newcastle and the increase in their emissions will affect the quality of air in suburban areas close to major traffic thoroughfares. Similarly, localised effects can be expected from the emission of pollutants from businesses and industry throughout Newcastle. The influence of meteorological factors and emissions from sources that fall within the control of Council indicate the need for an airshed management plan. The NAMAP has been developed to specifically target pollution from sources that Council can directly influence through regulation and indirectly influence through the provision of leadership and guidance. This influence is aimed at pollutants from these sources not adversely affecting air quality and public health.

The Newcastle Air Emission Inventory (NAEI) completed by NCC in 2004 has shown that industrial, domestic and transportation sources can all contribute to adverse air quality in the city. The main pollutants of concern are detailed and include carbon monoxide, particulate matter, nitrogen dioxide, sulphur dioxide, volatile organic carbons and ozone. Pollutants and their impact upon the Newcastle airshed are detailed in Section 5.

The NAMAP has been developed to reflect Council's responsibilities in having a leading role in all of the specific actions identified. The actions are grouped under nine key topics. These topics are council operations, energy efficiency, regional cooperation, land use planning, transport, vehicle emissions, business and industry, regulation and enforcement and community involvement.

The NAMAP aims to provide Council and the community of Newcastle with appropriate strategies and actions for implementation which will result in an improvement of local and regional air quality. The NAMAP will be subject to ongoing evaluation and review to determine whether the aims and actions are still appropriate and if actions are being completed. Information obtained from the evaluation and review processes will provide input to the future development of actions to continuously improve the air quality of Newcastle in line with the aims of the NAMAP. The plan has been developed under the guidance of Council's technical and community consultative committee "Environmental Protection and Pollution Advisory Committee" (EPAPAC). Reporting of implementation and status of the actions will be through annual State of the Environment reporting and presentation to EPAPAC.

1. Introduction

1.1. History

Newcastle had an early history of heavy particulate loadings and acid gas emission. It was in this background that a Smoke Abatement Advisory Panel was established in 1947 to reduce the impact of industrial emissions on air quality. After having its name changed to the Air Pollution Advisory Panel it continued in its role of reducing particulate pollution and sulphur dioxide emissions to the atmosphere up until it ceased in 1984. Council formed the still functioning Environmental Protection and Pollution Advisory Committee (EPAPAC) in 1988 with a strengthened role to deal with the pollution of air and water as well as noise and land issues.

In 1994, in collaboration with the community, Newcastle City Council (NCC) developed the Newcastle Environmental Management Plan (NEMP). The community had identified air quality as an important aspect of improving the environment in the City of Newcastle. The NEMP contained a range of strategies with a key strategy for the improvement of air quality being "Prepare an Airshed Management Plan to identify sources, emissions concentrations and options to improve air quality in the City and region".

Subsequently in 1998, Newcastle City Council developed an integrated **Newcastle Airshed Management Action Plan** (NAMAP) to improve air quality of the local and regional airsheds and to manage air pollutants, which may impact on global air quality. NAMAP 1998 contained 11 key issues each of which had a framework for management containing specific objectives, target pollutants and responsibilities. There were 226 actions listed in the NAMAP that were to provide a basis for future management of air quality and put in place a robust measuring and reporting structure.

1.2. Background for review of NAMAP

A review of the NEMP was undertaken in 2003 to address implementation and changes since the original NEMP was released in 1994. The 2003 NEMP connects the institutional, economic and social systems with the environment to ensure its viable health, and determine the effectiveness of planning and management efforts. The major strength of the 2003 NEMP is that it takes a systems approach, recognising the dynamics and interconnection of natural systems and also the organisational and social systems that often determines issues response. This important component draws connections between themes and provides for the delivery of a range of sustainability outcomes through a single management action. A prior action for Air in the NEMP was to "Review and implement NAMAP".

1.3. Status of NAMAP 1998

As Newcastle has discarded the image of an industrial city with poor air quality, since the introduction of the 1998 NAMAP (following the closure of BHP's integrated steelmaking plant), a review was undertaken to ascertain the success of its implementation. The review of the implementation of the 1998 NAMAP (see Appendix 2) revealed that most key issues had around 50% of their actions implemented. The key issues relating to "Improving energy efficiency" and "Enhancing air quality management of Newcastle Council activities" had more of their actions implemented. The key issues least actioned were "Reducing the growth in Vehicle Kilometres Travelled" and "Monitoring air quality". This indicated that actions where Newcastle Council had most influence or ownership had greater levels of implementation.

1.4. Current status of Newcastle

There have been significant changes in population in Newcastle City in recent years. In 2003, the City of Newcastle supported around 137,000 people an increase from around 133,000 in 1998. Newcastle is currently attracting about 1,000 new residents a year because of urban consolidation and an improving residential environment. Newcastle is the regional centre of the Hunter Valley with people from around the Hunter Region travelling to Newcastle for employment, recreation, learning and educational services, and health services. Increased population and travellers will lead to increased emissions from residential sources and associated services. A recent survey of community attitudes has found that the description "Newcastle's air is clean and clear" has a high level of support.

The growth in motor vehicle usage in Newcastle has been 3% to 4% per year with total vehicle kilometres travelled increasing at more than double the rate of the population growth. This trend means more people own more cars and despite technological improvements reducing emissions from new

vehicles, these gains are offset by the continuing growth in the use of motor vehicles.

The Greenhouse Action in Newcastle (GAIN) plan was developed in 2001 to address the growing need to manage Newcastle's contribution to greenhouse emissions. Newcastle's total energy and resource consumption is monitored and reported through ClimateCam (a computer based measurement tool that tracks greenhouse gas emissions for the City of Newcastle). As Newcastle's total energy consumption continues to increase, associated emissions also increase. Emissions other than greenhouse gases result from the consumption of fossil fuels and add to the degradation of ambient air quality.

Recent studies of air quality including the Newcastle Air Emission Inventory (NAEI) 2004 have shown that adverse air quality in the city is contributed to by the emissions from industrial, domestic and transportation sources. Motor vehicles, with their ever increasing numbers and subsequent emissions, provide the greatest immediate challenge to Newcastle and to the quality of air in the region. Major influences in the reduction of pollutants in the past have been the conversion to Natural Gas, Closure of BHP's Intergrated steelmaking plant and the changes to Motor Vehicle design rules.

Many of the air quality issues that face Newcastle lie with National and State government, and Council needs to continue to provide a strong leadership and advocacy role in areas that it can influence. Council also needs to continue to work with regional organisations to pursue research and planning issues, deliver community education programs, conduct industry audit programs and identify the source, nature and link between fine particulate and health.

The achievement of these goals through the review of the NAMAP and implementation of its actions is the path to improved air quality for Newcastle.

1.5. Aim of the NAMAP

The aim of the NAMAP remains as it was specified in the original NAMAP in 1998. This is *"to improve air quality at the local and regional scales and to manage air pollutants, which may impact on global air quality."* The NAMAP seeks to achieve this through reducing the emission of those air pollutants from within the Newcastle airshed.

Many of the airshed management plans produced in Australia at a local government level were examined to provide direction in the review of the NAMAP. This examination revealed that all, except those covering regional areas, produced airshed management plans concentrating upon the actions of their local government body and factors that could be influenced by that body. This was considered an important factor during the consideration of actions for inclusion in the NAMAP.

A blend of strategic areas from NAMAP 1998 and those from NEMP 2003 were derived to cover the range of actions selected to constitute the NAMAP. These key areas form the framework for the action plan.

- Council's Operations
- Energy Efficiency
- Regional Cooperation
- Land Use Planning
- Transport
- Vehicle Emissions
- Business & Industry
- Regulation & Enforcement
- Community Involvement

2. Regulatory Framework

Legislation relating to air quality in New South Wales exists as Acts of Parliament and associated Regulations. Council is responsible for the regulation of all non-scheduled premises and their activities under the Protection of the Environment Operations Act 1997 (POEO). The associated regulations specific to air quality are:

- The Clean Air (Plant and Equipment) Regulation 1997 (currently under review). Sets maximum emission levels from certain premises of a number of substances, including chlorine, dioxins, furans, hazardous substances, smoke, soot, solid particles and sulphur; deals with the transport and storage of volatile organic liquids; and restricts the use of high sulphur liquid fuel;
- The Protection of the Environment Operations (Penalty Notices) Regulation 2004. Sets out the offences under the Protection of the Environment Operations Act 1997 and related Acts and regulations for which on-the-spot fines ('penalty notices') may be issued, and the amount of such fines and specifies the organisations who can authorise their officers to issue penalty notices for particular offences;
- The Protection of the Environment Operations (Control of Burning) Regulation 2000. Controls burning in the open or in incinerators in local government areas; allows the EPA or local councils to grant approvals for burning in the open or in an incinerator in certain circumstances; prohibits the burning of certain articles (including tyres, paint and solvent containers, and certain treated timbers); and imposes a general duty on persons to prevent or minimise air pollution when burning in the open or in an incinerator and
- The Protection of the Environment Operations (Clean Air) Regulation 2002. The Regulation deals with the sale of domestic solid fuel heaters and requires the heaters to be certified as complying with emission limits set out in the relevant Australian Standard. It also prohibits tampering with such heaters. In relation to motor vehicles, the regulation deals with the emission of air impurities, including excessive smoke from motor vehicles; the compulsory fitting and maintenance of anti-pollution devices, and exemptions from these requirements; and the method of transfer of petrol into a vehicle's fuel tank.

3. Air Pollutants and Standards

3.1. Air Pollutants

There are a large number of pollutants, which have historically been shown to impact on air quality in the Newcastle airshed. The following six major urban air pollutants are currently thought to present the greatest risk to the health and well being of the population of Newcastle.

- Carbon Monoxide
- Nitrogen Oxides
- Sulphur Dioxide (SO_2)
- Volatile Organic Compounds (VOCs)
- Fine Particles as PM_{10}
- Ozone (O_3)

There is also an increasing focus on finer particles described as $PM_{2.5}$ (Particulate Matter <2.5μm) although research has been impacted by the limited amount of monitoring undertaken for this pollutant. Medical research confirms that fine particulates represent a significant health risk to urban communities and more recently $PM_{2.5}$ has been shown to play a more important role in the long-term effects attributable to particles. As well, dust, smoke and odours occasionally impact upon the amenity of some of the residents of Newcastle. Figure 1 shows a breakdown of complaints received by Newcastle Council.

3.2. Air Pollution Standards

In June 1998, the National Environment Protection Council (NEPC) agreed to set uniform standards for ambient air quality. The standards contained in the National Environment Protection Measure (NEPM) for ambient air quality are listed in Table 1. The desired outcome of the Measure was stated as "ambient air quality that allows for adequate protection of human health and well being".

The concentration of atmospheric pollutants often fluctuates greatly over time, corresponding to daily and seasonal weather patterns as well as the emissions. Motor vehicle emissions vary according to the number of vehicles on the roads with peak periods having higher concentrations of pollutants. Concentrations of pollutants also vary significantly within an airshed and are influenced by meteorological conditions.

Average concentrations over a selected time period are used to account for these fluctuations. Air quality objectives are also expressed in terms of average concentrations over a given period of time. The environmental impact of the particular pollutant determines the choice of averaging time. Short averaging periods (eg 1 hr) are used for pollutants having acute impacts over short time periods with objectives based on short averaging times because peak levels are important.

In 1998 the NSW Government released *Action for Air*, its 25-year air quality management plan for the Greater Metropolitan Region (GMR) covering Sydney, the Lower Hunter and the Illawarra with additional long term air quality goals adopted. These goals are listed below in Table 2.

Recent Australian studies have shown that PM_{10}, O_3 and NO_2 increase premature mortality at levels below ambient air standards and the effects are independent and additive (Morgan 2000) with major costs associated with increased air pollution.

Table 1: NEPM Ambient Air Standards and Goals

Pollutant	Averaging period	Maximum concentration	Goal within 10 years Maximum allowable exceedences
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year none
Photochemical oxidants (as ozone)	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
Sulphur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year none
Lead	1 year	0.50 µg/m^3	none
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year
Particles as $PM_{2.5}$	1 day 1 year	25 µg/m^3 8 µg/m^3	Goal is to gather sufficient data nationally to facilitate a review of the Advisory Reporting Standards as part of the review of this Measure scheduled to commence in 2005.

Table 2: NSW EPA *Action for Air* Goals

Pollutant	Averaging time	*Action for Air* Interim goal	Long-term reporting goal
Photochemical oxidants (as Ozone)	1 hour 4 hours	0.10 ppm 0.08 ppm	0.08 ppm 0.06 ppm
Nitrogen dioxide	1 hour Annual	0.125 ppm 0.03 ppm	0.105 ppm ---
Particulate Matter <10um (PM_{10})	24 hours Annual	50 µg/m^3	--- 30 µg/m^3
Total Suspended Particulates (TSP)	Annual	90 µg/m^3	

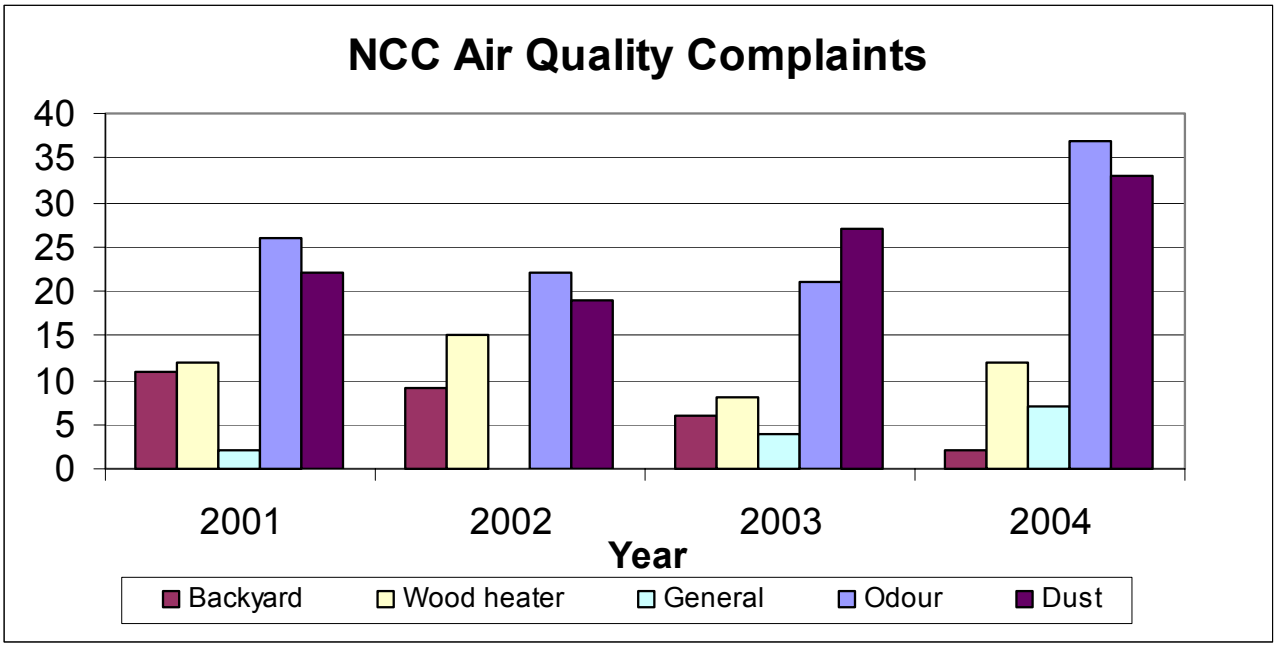


Figure 1: NCC Air quality Complaints

3.3. Air Pollution Complaints

Newcastle Council receives complaints on a variety of air related amenity issues as depicted in Figure 1. Calls to the Department of Environment and Conservation's Pollution Line (2002-2003) shows around 40% relate to odour and a further 10% for other types of air pollution (NSW DEC SOE 2003 Fig 2.15). Issues of amenity rate highly in complaints that are handled by Newcastle Council's Environmental Services staff. Complaints about smoke from backyard burning and domestic wood heater operations are common. As can be seen from Figure 1 there has been a reduction in the number of complaints from backyard burning incidents, in recent years, as knowledge of the ban on backyard burning increases.

The number of complaints from incorrectly operated wood heaters is steady with education programs targeting this issue being released prior to the winter season. Odorous air pollutants are considered important due to their nuisance value but are difficult to resolve due to their often transient and subjective nature. Odours are often generated by industrial and agricultural activities with their close proximity to residential locations one of the main factors leading to complaints being made. Dust is another major pollutant that generates complaints. Dust is large particles that are visible on surfaces as a residue. The complaints are mainly based on activities associated with the movement of quantities of soil or demolition of buildings associated with development activities.

4. Where does Newcastle's Air Pollution come from?

As a city based on heavy industry, the perception has been that industry is the source of all pollution. This perception has been changing since the closure of BHP's Newcastle integrated steelworks in September 1999. An action from NAMAP 1998 that was directed at small and medium enterprises was to "Prepare an Inventory of pollutant sources impacting on the city airshed". In 2001, NCC in partnership with the University of Newcastle commenced research and planning to prepare an air emissions inventory as part of NCC's Airshed Management Plan.

An emission inventory is a comprehensive listing, by significant sources, of the estimated emissions of specific air pollutants, for a specific geographic area and a specific time interval. Inventories group significant sources of air emissions into general categories, such as, major industrial point sources; mobile sources (road, rail and marine transport emissions); area-based sources (emissions from light industrial, smaller commercial and residential activity); and biogenic or natural sources. The major air pollutants emitted from these sources and commonly evaluated in air emission inventories are carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), volatile organic compounds (VOCs) and fine particles as PM_{10} (particles less than 10 micrometres in diameter).

This recently completed Newcastle Air Emission Inventory 2004 (NAEI) provides information on the main sources of air emissions and their relative contributions in the Newcastle local government area. The inventory also provided a baseline data set from which to compare future improvements. This information could be used in air quality management planning and was used to underpin the review of the NAMAP.

The NAEI provides Newcastle City Council with the technical foundation to assist development and assessment of options for air quality management. This is accomplished by identifying the main emission sources, the nature of local air pollution issues, as well as sources with the potential for emission reductions. The inventory provides a breakdown of estimated total mass emissions of specified pollutants across the Newcastle Local Government Area for a specific year. In locations where air quality is of concern, the emission inventory can be used to identify the main contributors to emissions of a pollutant of concern and identify major sources. Thus, the inventory is a tool for identifying the specific sources that should be targeted if a reduction in emissions is required. Trends in those emission sources may be identified during further refinement of the air emission inventory for Newcastle.

Details of the sources, distribution and contribution of each of the criteria pollutants that were detailed in the inventory are summarised in the following sections.

4.1. Carbon Monoxide

Carbon Monoxide (CO) is a colourless, odourless and highly flammable gas. CO is formed when carbon in fuels (petrol, wood, coal, natural gas, etc.) is not burned completely. CO although not considered a greenhouse gas is a precursor to greenhouse gases, eventually oxidising into carbon dioxide.

Health impacts

CO inhaled into the lungs rapidly enters the blood, reducing the oxygen carrying ability of the blood. CO concentrations in ambient air are unlikely to cause ill effect. Harmful levels may occur in poorly ventilated areas during operation of unflued gas heaters, or from defective non-electric heating appliances, and motor vehicles with defective exhaust systems. Such exposure may cause poor concentration, memory and vision problems, and loss of muscle coordination. Exposure at higher levels (200 parts per million (ppm) for 2-3 hours) may cause headaches, fatigue, and nausea. Symptoms intensify at very high levels (400 ppm), becoming life threatening after 3 hours. Immediate danger to life may occur at exposure levels of 1200 ppm. Long term low-level CO exposure may produce heart disease and nervous system damage. CO exposure among pregnant women may cause low birthrates and nervous system damage in their children.

Emissions

Carbon monoxide is predominantly emitted from mobile sources with motor vehicles contributing 78% (see Figure 2) of the estimated total load of 25,400 tonnes per year that is emitted into the NCC airshed.

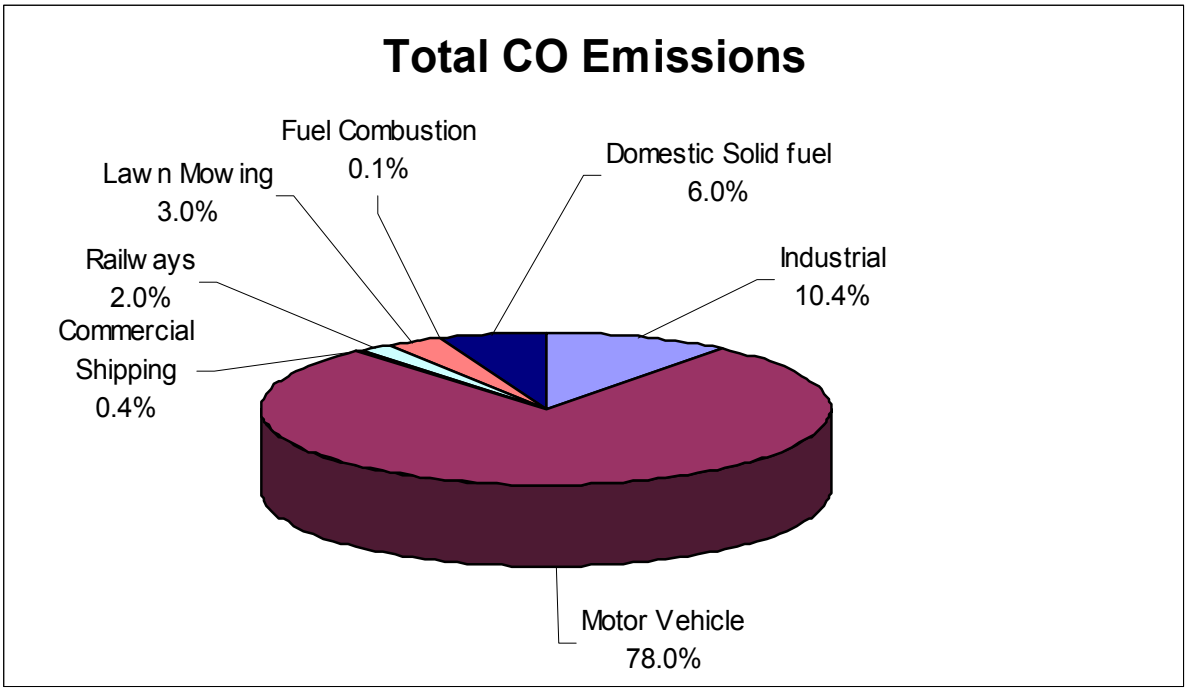


Figure 2: Sources of Carbon Monoxide emissions in Newcastle (2000)

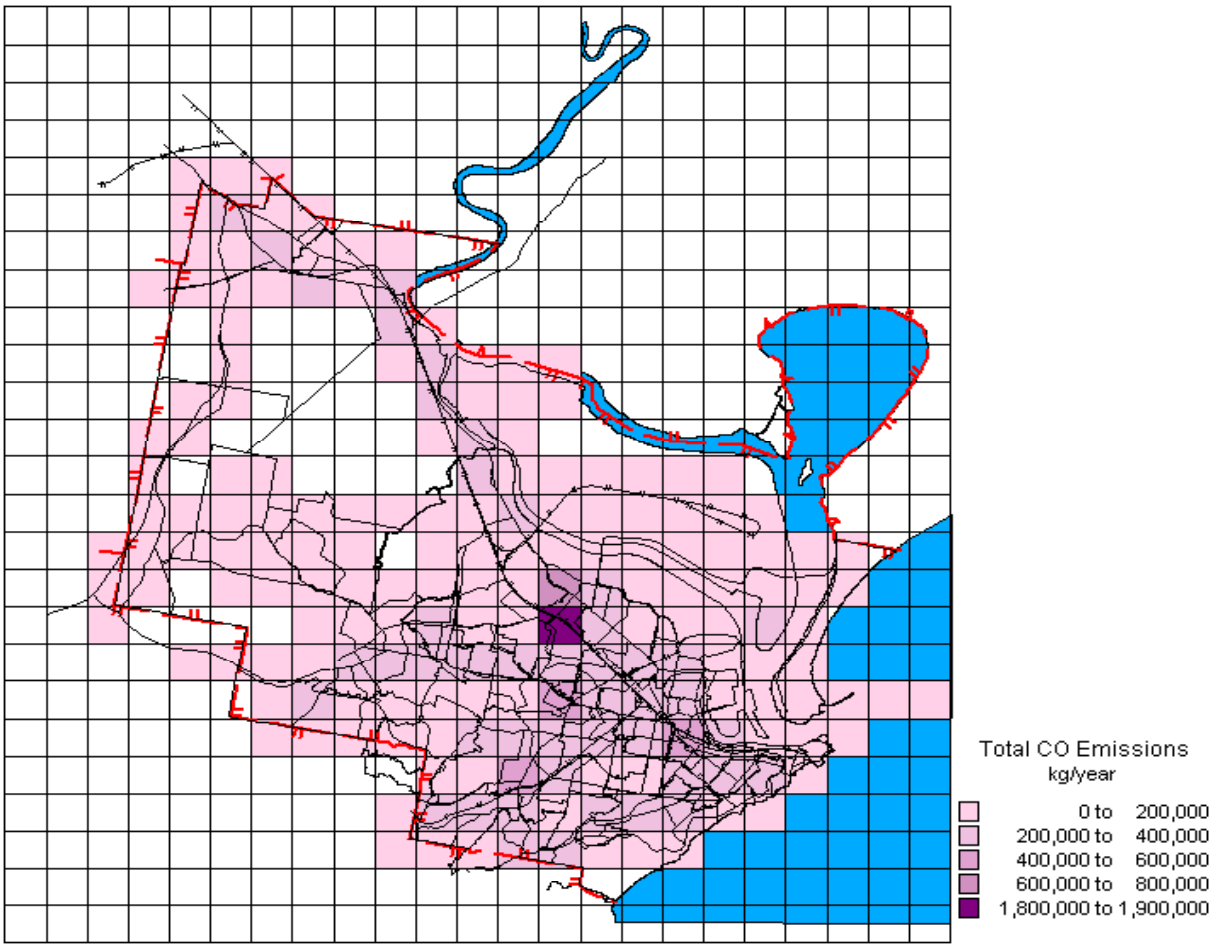


Figure 3: Distribution of Carbon Monoxide emissions in Newcastle (2000)

With motor vehicles the major contributor to CO emissions within the Newcastle LGA, Figure 3 shows emission levels, apart from one major industrial source, are greatest along major road routes and somewhat increased along the rail corridors.

Emissions from wood heaters in residential zones occur predominantly in winter during mornings and evenings. The annual level of emissions estimated from domestic solid fuel combustion is estimated to be 1,530 tonnes of CO per annum which is 6% of the total estimated annual load. The main summer season emission from residential sources is from lawn mowing which produces 3% of the total estimated load of CO emissions.

4.2. Nitrogen Oxides

Nitrogen Oxides (NO_x) are generated when combustion takes place at high temperatures with atmospheric nitrogen and oxygen combining to form nitric oxide (NO). NO (Nitric Oxide) gas is usually colourless or brown in high concentrations, with a sharp, sweet odour. It is slightly soluble in water, to form nitrous acid (a weak acid). NO_2 (Nitrogen Dioxide) is a dark brown, pungent, acidic gas with an acrid odour that is detectable by human beings at 0.12 parts per million (ppm). NO_2 is corrosive, reacting strongly with oxygen. It is highly soluble in water, forming nitric acid (a strong acid). N_2O (Nitrous Oxide) is a colourless gas with a slight sweetish odour, non-flammable, and has anaesthetic properties. In the lower atmosphere, the presence of sunlight and ozone (formed from photochemical reactive volatile organic compounds) accelerate the oxidation of nitrogen to form photochemical smog.

Health impacts

Concentrations of NO_2 above health standards can cause inflammation of the lung tissue and impairment of the lung's immune system. Epidemiological studies suggest that young children are especially susceptible. NO_2 exacerbates the effects of exposure to other known irritants such as ozone, sulphur dioxide and fine particles.

Emissions

The inventory identifies motor vehicles as the major airshed contributor of Nitrogen Oxide (NOx) emissions with 53.4% (see Figure 4) of the total load of 4,800 tonnes per annum. This is followed by industrial sources with 18.8% and the other mobile sources commercial shipping (16.1%) and railways (9.3%).

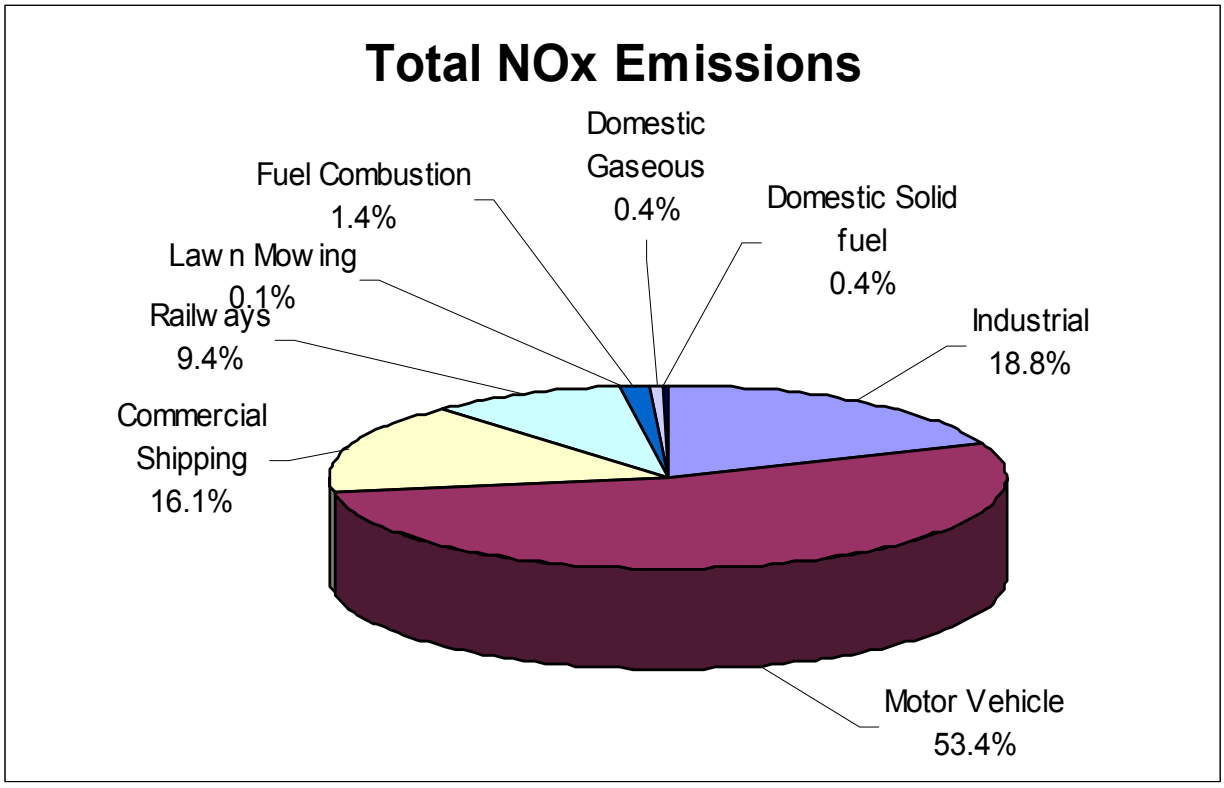


Figure 4: Sources of Nitrogen Oxides emissions in Newcastle (2000)

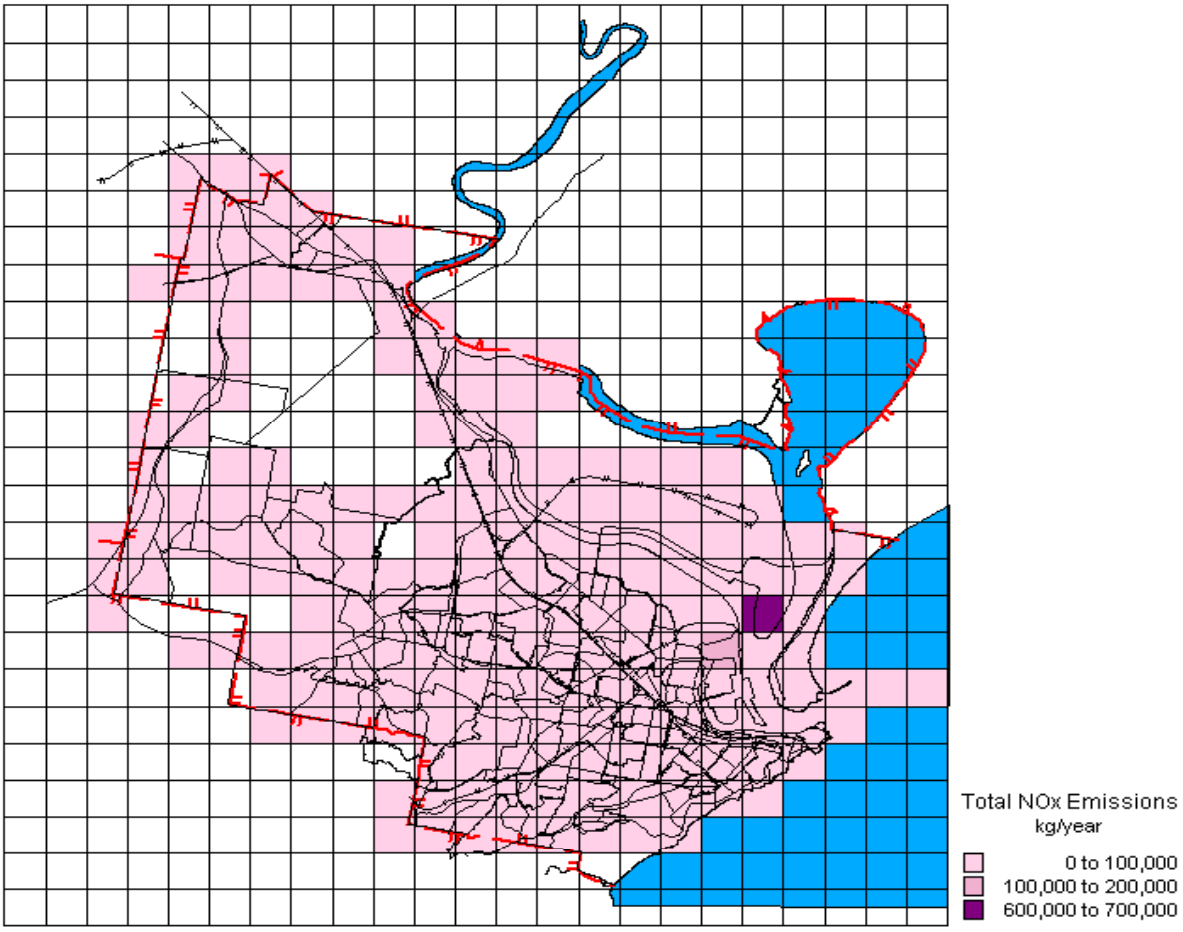


Figure 5: Distribution of Nitrogen Oxide emissions in Newcastle (2000)

As shown in Figure 4 motor vehicles are the major source of to NO_x emissions within the Newcastle LGA. Figure 5 shows that with the exception of one major industrial source there is a uniform distribution of NO_x emissions within the Newcastle LGA. This reflects the distribution of motor vehicles and other transport sources as the major contributors to NO_x emissions.

4.3. Sulphur Dioxide

Sulphur Dioxide (SO_2) is a colourless, pungent, irritating and reactive gas. SO_2 is formed as a by-product of the combustion of fuels containing sulphur or sulphur compounds. SO_2 oxidises to sulphur trioxide, which dissolves in water to form sulphuric acid. Excessive concentrations of SO_2 may harm plants and trees and reduce crop productivity. Very high levels, especially associated with acid rain, adversely affect both land and water ecosystems.

Health impacts

SO_2 concentrations of 10 to 50ppm irritate the eyes, skin and upper airways causing choking and coughing, headache, general discomfort and anxiety. Repeated or prolonged exposure to moderate SO_2 concentrations may exacerbate cardiovascular conditions and respiratory illnesses such as asthma. SO_2 is harmful to the reproductive systems of experimental animals, causing developmental changes in their newborn.

Emissions

Mobile sources dominate the emission of sulphur dioxide in the NCC airshed as shown in Figure 6 below. Emissions from commercial shipping (37.6%) are followed by motor vehicles (27.4%) and railways (10.6%). Industrial sources are the remaining major contributor with 23.5% of the estimated total load of 1,640 tonnes.

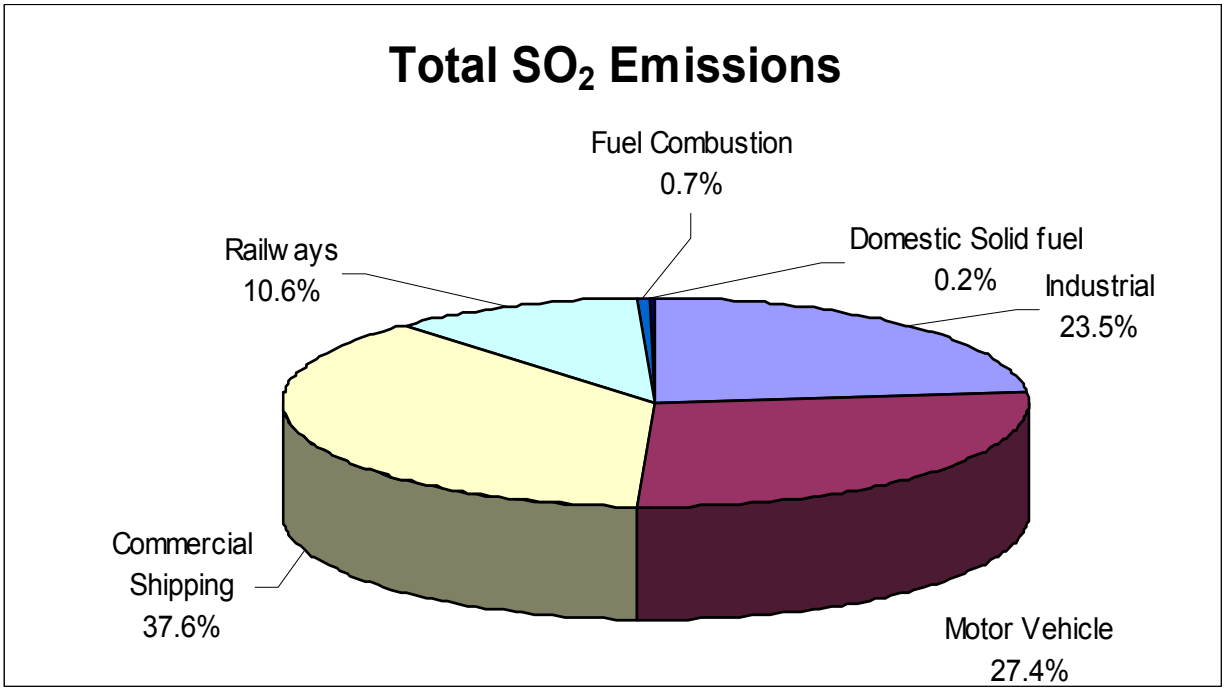


Figure 6: Sources of Sulphur Dioxide emissions in Newcastle (2000)

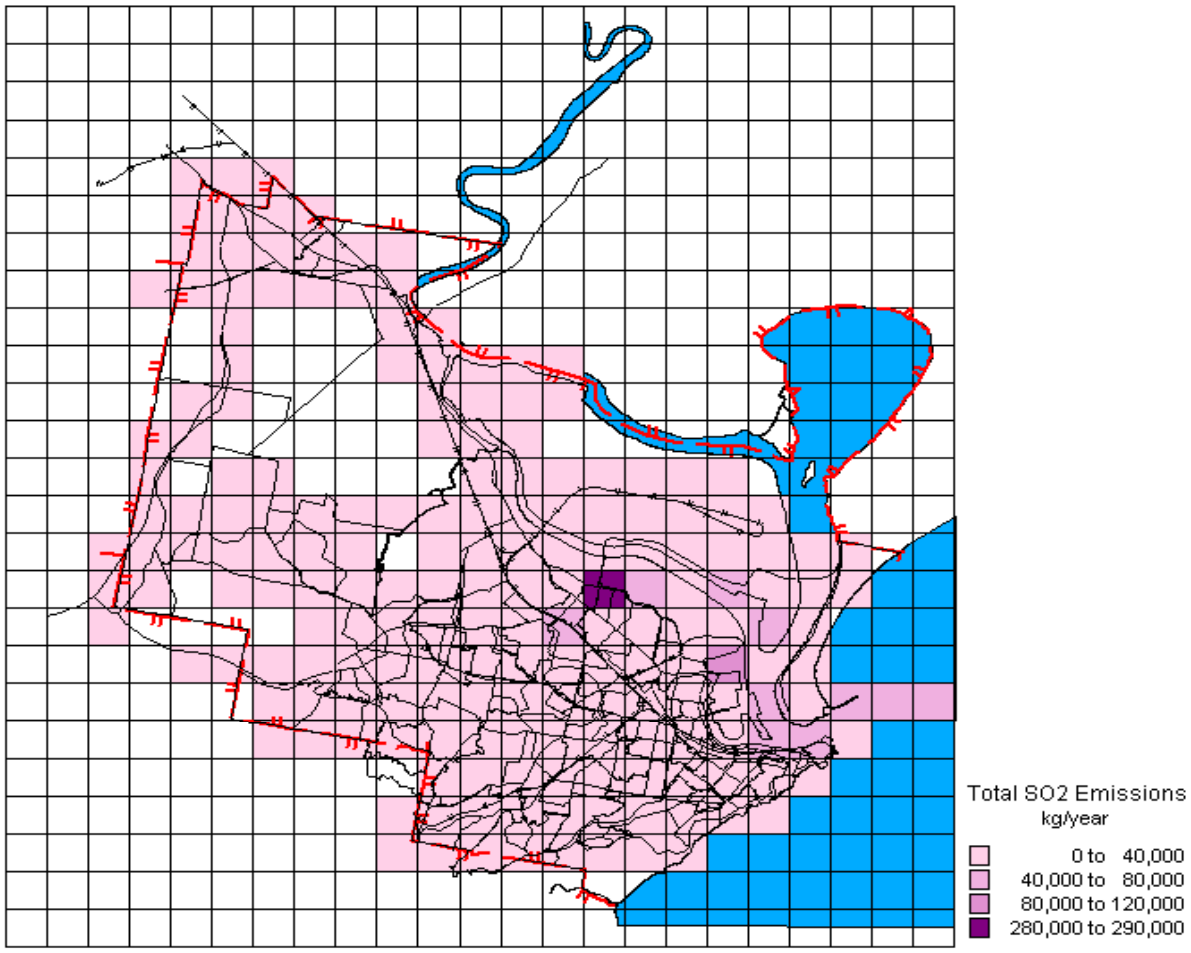


Figure 7: Distribution of Sulphur Dioxide emissions in Newcastle (2000)

As mobile sources (motor vehicles, commercial shipping and railways) are the major contributor to SO_2 emissions these emission levels are reflected in Figure 7. The emission concentrations are represented by major roads, rail lines, shipping berths and shipping channels. Industrial areas also feature prominently in Figure 7 with elevated emission levels associated with the traditional industrial areas of Newcastle.

4.4. Volatile Organic Carbons

Volatile Organic Compounds (VOCs) include substances made up of predominantly carbon and hydrogen (organic chemical compounds), excluding pesticides. VOC's form a percentage of most fossil fuels and are emitted from most transportation and industrial processes. VOCs generally evaporate quickly at normal ambient air temperatures. Atmospheric VOCs, in the presence of sunlight, react with other compounds in the atmosphere, such as oxides of nitrogen, to form photochemical smog.

Health impacts

The health effects vary depending on the nature of the exposure to the specific VOC. Lower concentrations generally cause irritation to eyes, skin and respiratory tract, headaches, dizziness, nausea. Higher concentrations may result in damage to liver, kidney and central nervous system. Exposure to some VOCs may result in cancer and birth defects.

Emissions

Emissions of Volatile Organic Carbons (VOC's) are dominated by motor vehicle emissions with 37.8% of the total as shown in Figure 8. There is also a variety of other sources contributing to the total of VOC emissions in the NCC airshed. Industrial emissions (15.0%), domestic and commercial solvent emissions (11.4%) and domestic solid fuel combustion (9.7%) are the three largest non motor vehicle VOC emission sources. This is then followed by architectural (building construction and painting) emissions (8.8%) and service station emissions with 5.7% of the estimated total load of 6,200 tonnes of VOC's emitted to the NCC airshed.

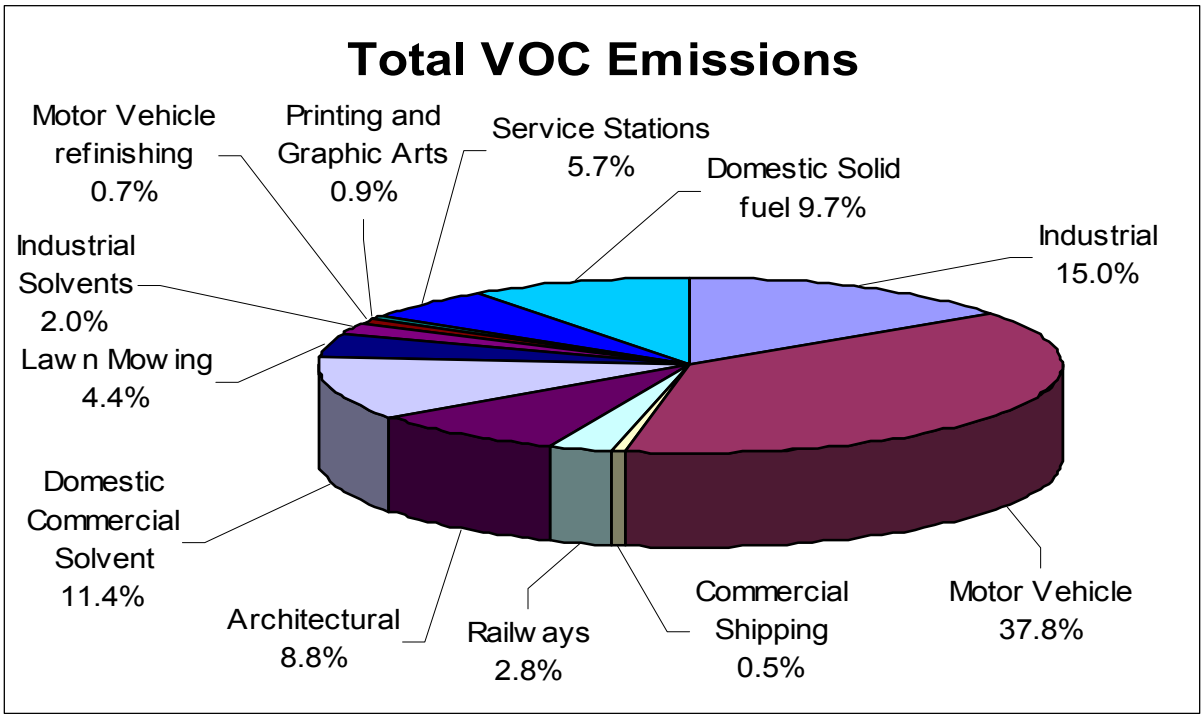


Figure 8: Sources of Volatile Organic Carbon emissions in Newcastle (2000)

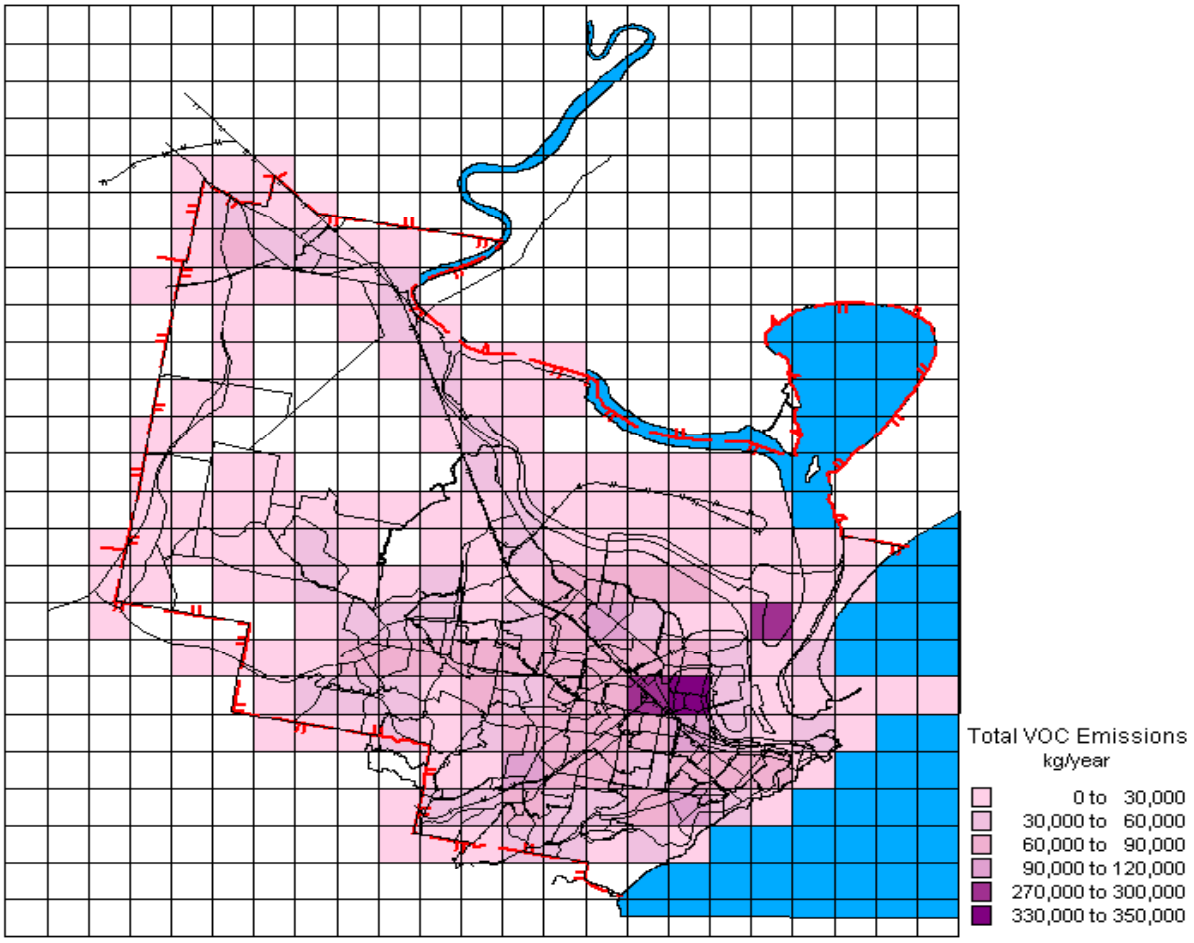


Figure 9: Distribution of Volatile Organic Carbon emissions in Newcastle (2000)

Motor vehicles and industrial sources within the Newcastle LGA are the major contributor to VOC emissions. Emission levels reflect the distribution of major roads and industrial areas as shown in Figure 9. Some increased emission levels relate to the distribution of commercial areas within Newcastle. The points of higher emissions in Figure 9 relate to the location of the three major petroleum storage and distribution centres in Newcastle.

4.5. Fine Particulate (PM_{10})

Fine particles are a mixture of different compounds and pollutants that originate mainly from combustion sources such as motor vehicles and industrial processes. PM_{10} includes fine dust particles, of any substance, that are less than 10 micrometres diameter. Particles within this size range may be drawn deeply into the lungs. Particles larger than PM_{10} tend to be trapped in the nose, mouth or throat.

Health impacts

Effects vary depending on the composition, concentration, and duration of exposure and size of the particles (smaller particles tend to have more severe effects because they may be inhaled more deeply into the lungs). Recent epidemiological research suggests that there is no threshold at which health effects do not occur. Health effects include:

- Toxic effects from absorption into the blood eg from lead, cadmium, and zinc
- Allergic or hypersensitivity effects eg some woods, flour grains, chemicals,
- Bacterial and fungal infections from live organisms among the dust,
- Fibrosis from exposure to asbestos, quartz,
- Cancer from exposure to asbestos, chromates,
- Irritation of mucous membranes eg from exposure to acid and alkalis.

Emissions

Long term harmful effects on lung function causing marginally increased death rates and sickness in sensitive people. Figure 10 shows that Fine Particulate (PM_{10}) emissions are dominated by industrial sources with 51.5% of emissions. Other contributions are from domestic solid fuel combustion at 17.5% and the three mobile sources (motor vehicles, rail and shipping) contributing to the majority of the remaining 31%. The estimated total load of Particulate Matter less than 10 microns (PM_{10}) emitted to the NCC airshed is around 1000 tonnes.

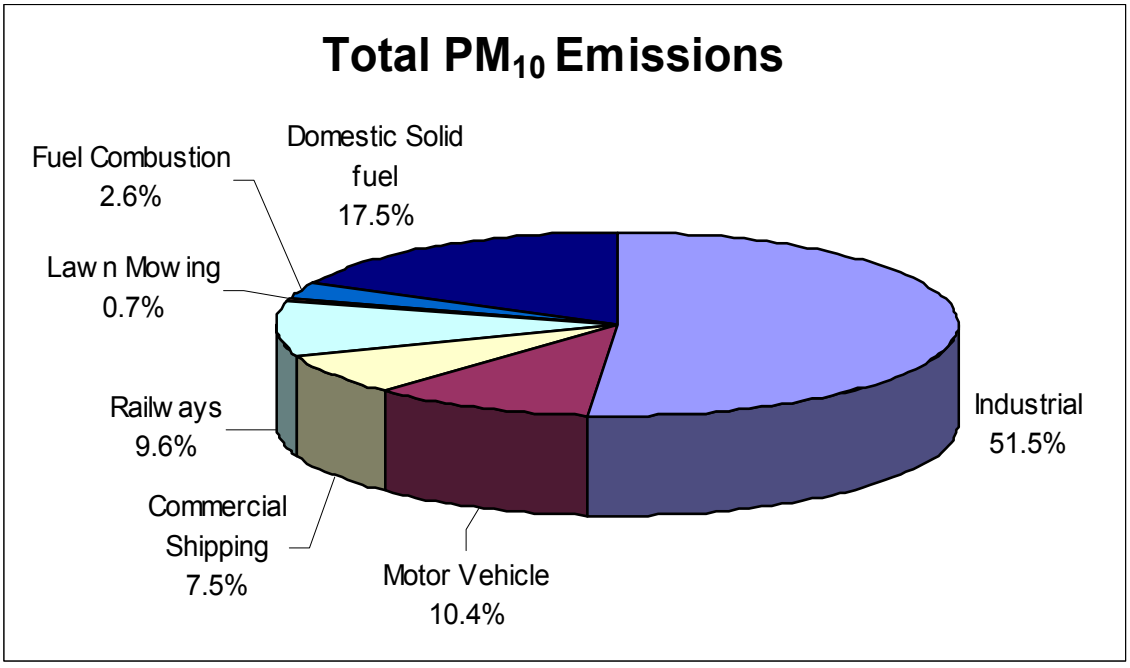


Figure 10: Sources of PM_{10} emissions in Newcastle (2000)

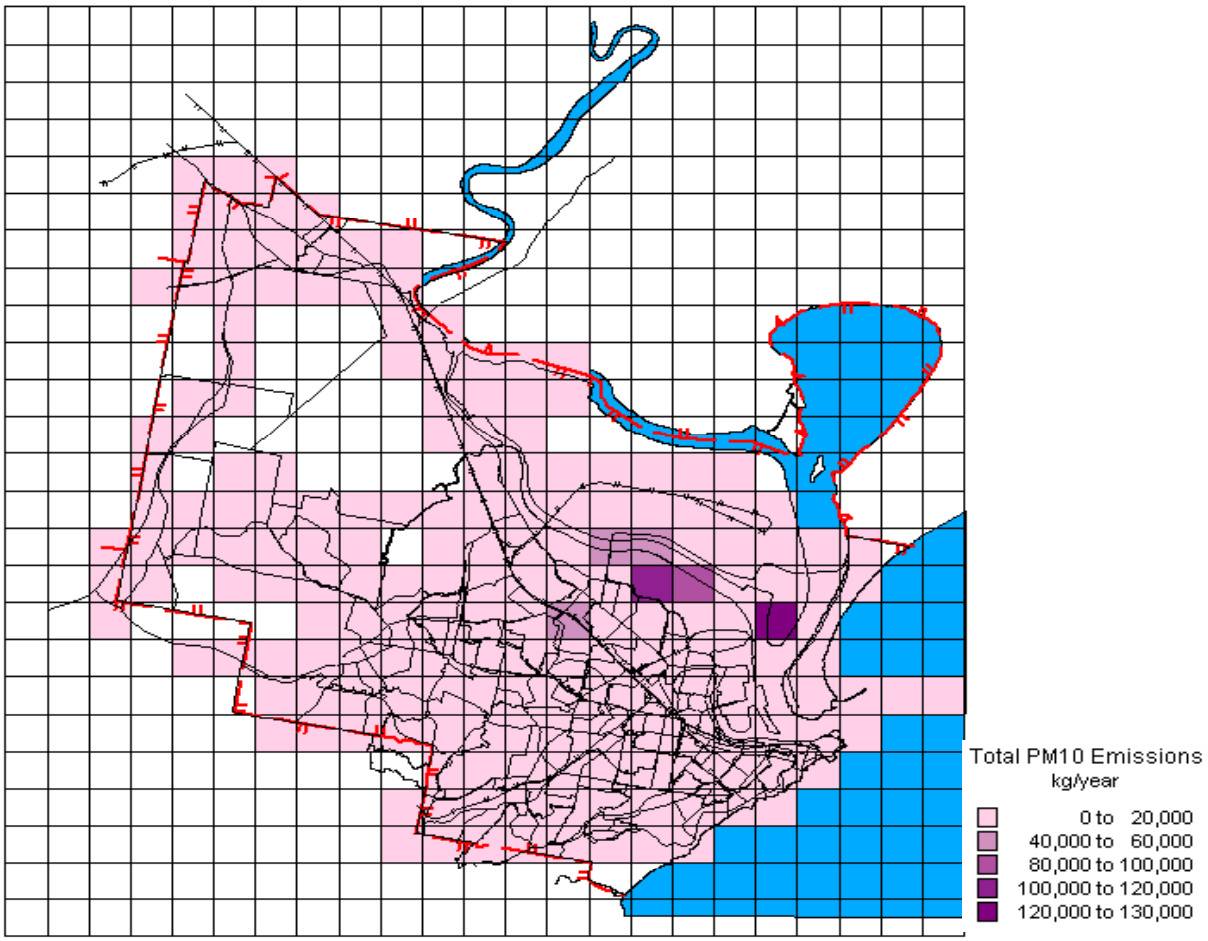


Figure 11: Distribution of PM_{10} emissions in Newcastle (2000)

As shown in Figure 11 industrial sources account for the largest contribution to PM_{10} emissions within the Newcastle LGA. Mobile sources and domestic solid fuel combustion (woodheaters) are also significant contributors to PM_{10} emissions as shown by the spread of emission concentrations along major transportation routes and throughout residential areas.

4.6. Ozone

Ozone is a secondary pollutant, formed by complex chemical reactions between NO_x and VOCs in the presence of sunlight. These reactions consume NO_x but VOCs are more or less conserved, with the concentration of VOCs controlling the rate at which the reaction proceeds. Ozone will continue to be produced as long as there is sunlight to drive the reaction and NO_x available to react.

Health impacts

Observed effects of ground level ozone include:

- Irritation of the eyes and air passages,
- Increased sensitivity of the airways to allergic triggers for some asthma sufferers. There is some evidence that even concentrations below 0.12 ppm can increase hospital admissions for asthma and other respiratory conditions,
- Significant effects of ozone on lung function in people exercising even at concentrations below 0.08 ppm. The long-term significance of these effects is unknown,
- Increased susceptibility to infection.

Scientific data indicates that short-term reductions in lung function, affecting hundreds of thousands of people each year, occur when ozone goals are exceeded.

Emissions

Ozone was not one of the criteria pollutants that were part of the inventory as ozone is a secondary pollutant, formed by complex chemical reactions between NO_x and VOCs in the presence of sunlight.

4.7. Odour

Odours are difficult to characterise as individuals can react differently to them and they can come from a range of sources. Additionally, climatic or seasonal conditions, such as very calm weather, can exacerbate odour impacts, even at great distances from the source. Increasing population growth and urban development has resulted in residential areas encroaching on areas once only used for agricultural or industrial activities. Odour problems are considered one such conflict, with sources such as panel shops, food processing industries, sewage treatment plants, landfills and chemical manufacturing plants sometimes causing amenity problems.

Health Impacts

It is important to recognise that the emission of an odour does not readily indicate whether the emission will have significant impacts on human health. However, an odour is an indication that an emission exists.

4.8. Smoke

Smoke from domestic woodheaters and open fires are a major source of complaints during winter and a potentially significant health hazard. There are a number of different pollutants in woodsmoke including particles of differing sizes and chemical composition - many of which are potentially toxic and have unknown long-term effects.

Health Impacts

Studies from many regions around the globe have identified short-term increases in death rates and hospital admissions related to increased concentrations of woodsmoke in the air. The particles in woodsmoke can penetrate deeply into the lungs and irritate the airways, thus causing existing problems such as emphysema, chronic bronchitis or asthma to worsen.

4.9. Modelling of Emissions

Air emission dispersion models provide the ability to mathematically simulate atmospheric conditions and behaviour. They are used to calculate spatial and temporal fields of concentrations and particle deposition due to emissions from various sources. Dispersion models are widely used by environmental regulators in Australia, New Zealand, the United States of America, the United Kingdom and Europe, and industry well understands their limitations. AUSPLUME v5.0, or later, is the approved dispersion model for use in most applications in New South Wales. Dispersion models can provide concentration or deposition estimates over an almost unlimited grid of user-specified locations, and can be used to evaluate both existing and forecast emissions scenarios. In this capacity, air dispersion modelling is a useful tool in assessing the air quality impacts associated with existing and proposed emissions sources. The results of the dispersion modelling analysis can be used to develop control strategies that should ensure compliance with the impact assessment criteria.

Air emission inventories compiled by Lake Macquarie and Newcastle Councils were used to provide input data into research supported by both councils. This research, undertaken by Newcastle University, was to assess The Air Pollution Model (TAPM) as a tool to assist development and assessment of air quality management options. TAPM could be used to predict possible hot spots where NEPM goals are likely to be exceeded or examine the impact of major industrial or urban developments.

The aims of the research were to validate the application of TAPM for predicting meteorology and air pollutant concentrations in Newcastle and Lake Macquarie. Simulations were conducted for typical winter and summer periods with the emission concentrations predicted for worst case conditions.

Conclusions from the research related to:

- The TAPM model's ability to predict PM10, SO2, NO2 and O3 compared with other modelling verification studies,
- TAPM performed well in predicting meteorology for Newcastle compared with model verification studies in Australia, and
- Increasing the accuracy of the TAPM model's predictions requiring longer simulation periods than used in the current simulations.

Figure 12 & Figure 13 display the outputs for these worst case scenarios for PM_{10} emissions for winter and summer that were conducted as part of the modelling validation.

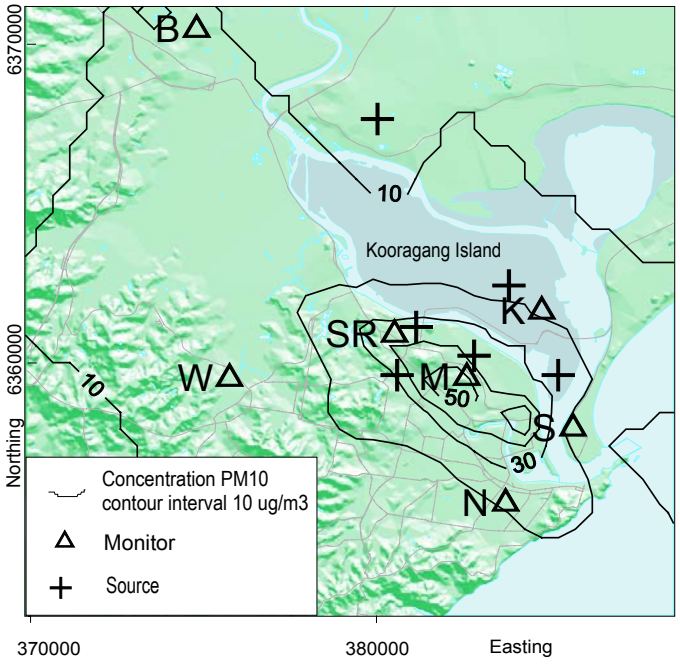


Figure 12: Predicted Maximum concentrations PM_{10} 24 Hr avg (summer) Source: University of Newcastle, NSW 2004

The distribution of emission concentrations in both the winter and summer scenarios exhibit a Northwest to Southeast alignment in close correlation to the location of major industrial sources and land zoned for industrial use.

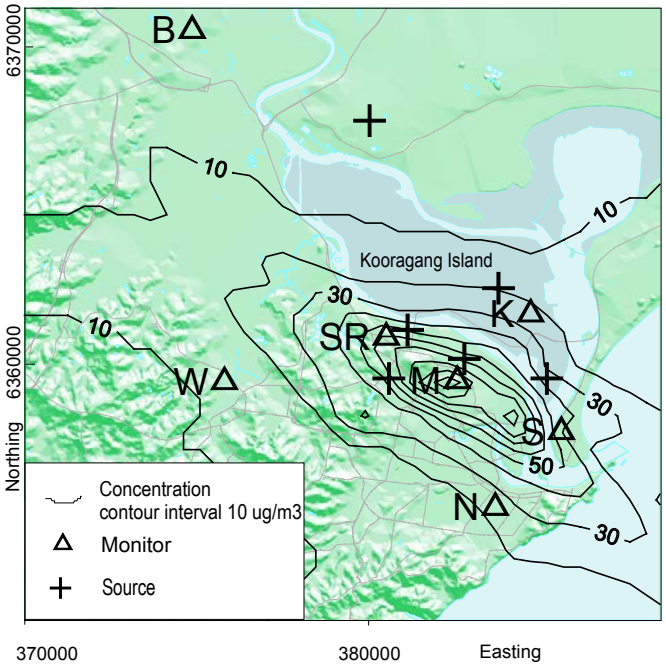


Figure 13: Predicted Maximum concentrations PM_{10} 24 Hr avg (winter) Source: University of Newcastle, NSW 2004

5. Air Quality trends in Newcastle

In summer, Newcastle can sometimes experience particulate pollution that approaches the guideline levels established. In addition, in winter a smoke haze can occur when pollution from woodheaters is trapped by weather conditions that prevent air pollutants from dispersing rapidly.

Newcastle Council, NSW Department of Environment and Conservation (DEC) and various industries have maintained monitoring stations around the Newcastle region for many years. Figure 14 illustrates the location of these stations.

The following graphs using data from these monitoring stations illustrate the quality of air in the Newcastle region particularly the improvements since the closure of BHP Steelworks in late 1999. Monthly results for particulate matter displayed on these graphs are averages of daily monitoring results. For the remainder of these graphs the annual monitoring result displayed is the average of the monthly result.

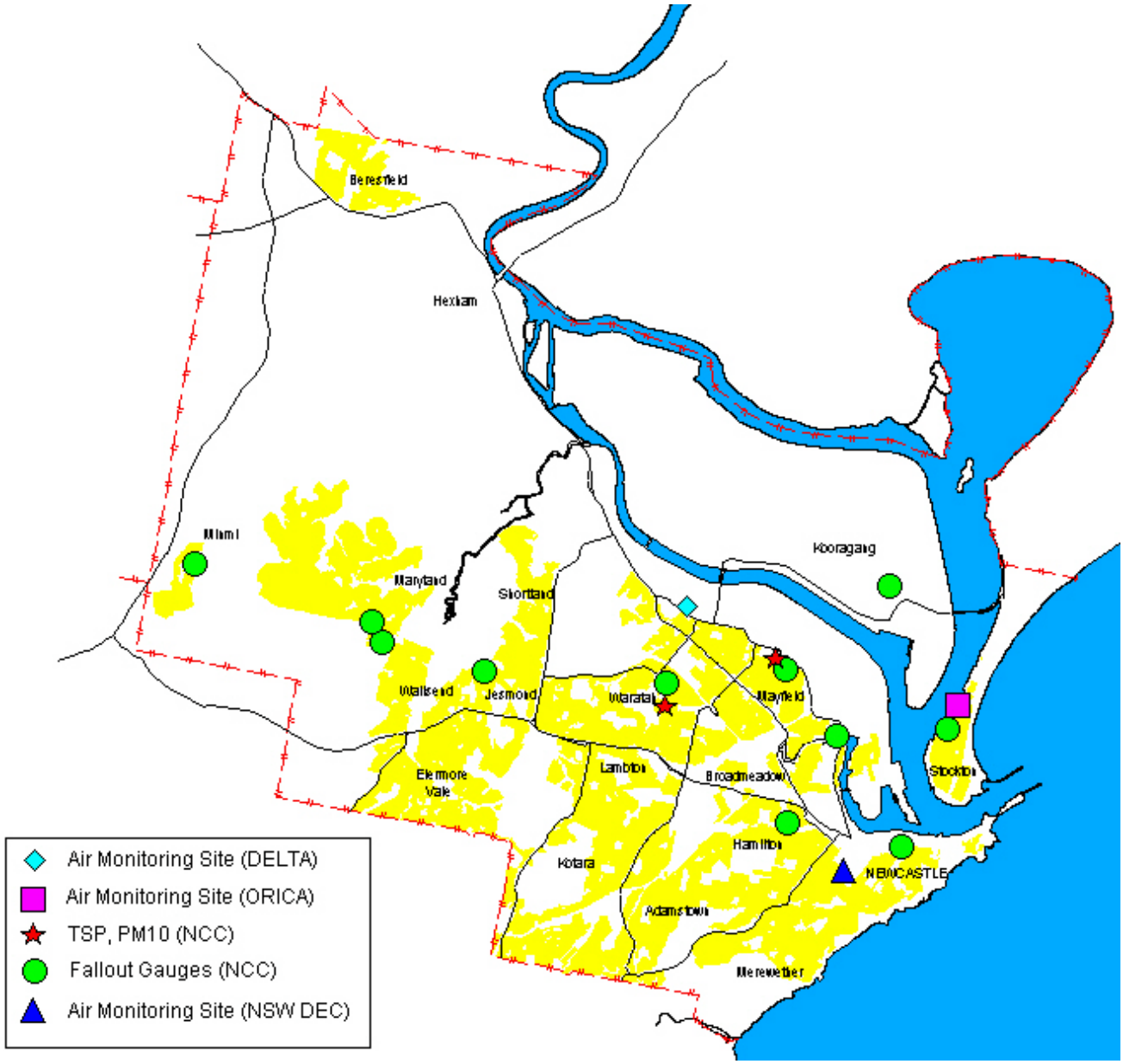
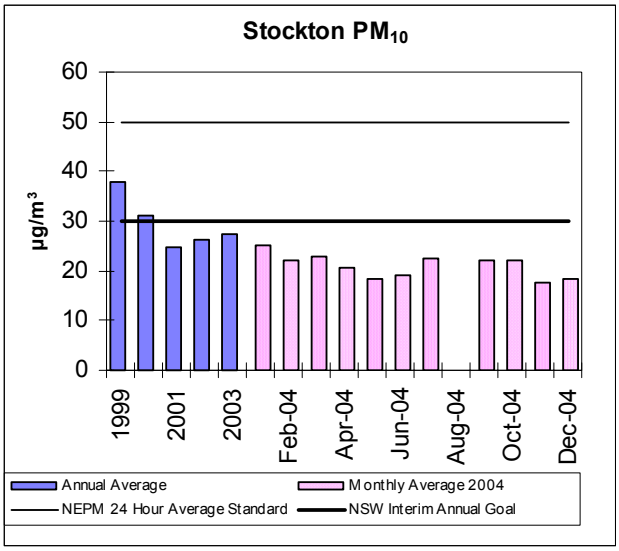


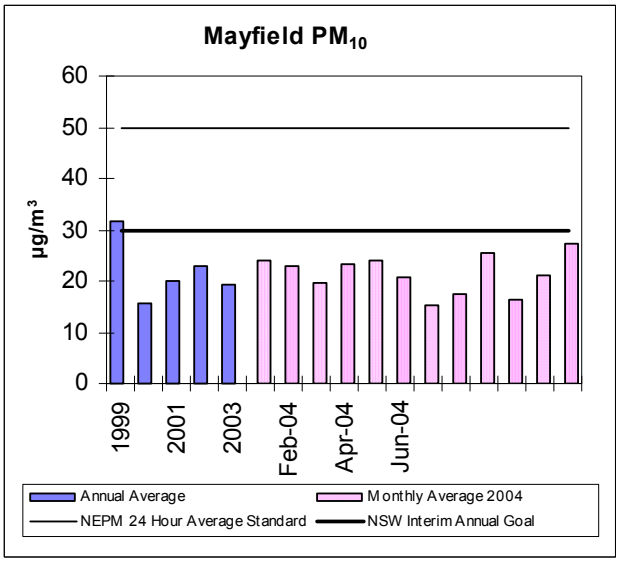
Figure 14 Air Monitoring Station Locations

The NEPM standard for fine particulates as PM_{10} is 50 µg/m^3 based on a daily average. This level was set to provide a significant reduction in health effects with the attainment of this goal.



Graph 1: PM_{10} Stockton Ambient Air Monitoring Station

The reduction in PM_{10} levels after the closure of BHP Steelworks in late 1999 is evident in the graphs for the monitoring stations in suburbs adjacent to the Steelworks. The Stockton and Mayfield monitoring stations had significant reductions in the PM_{10} levels monitored after September 1999

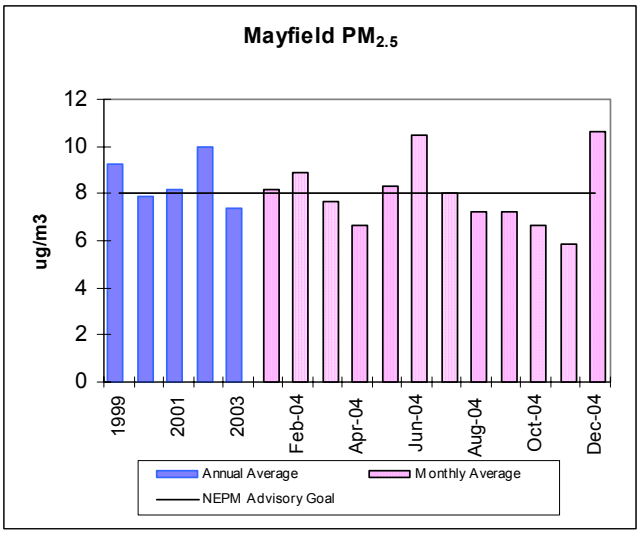


Graph 2: PM_{10} Mayfield Ambient Air Monitoring Station

Table 3: Exceedences of NEPM PM_{10} standard for Mayfield and Stockton

No. of Exceedences		
Mayfield	1999	11
	2000	0
	2001	2
	2002	0
	2003	0
Stockton	1999	11
	2000	4
	2001	1
	2002	1
	2003	0

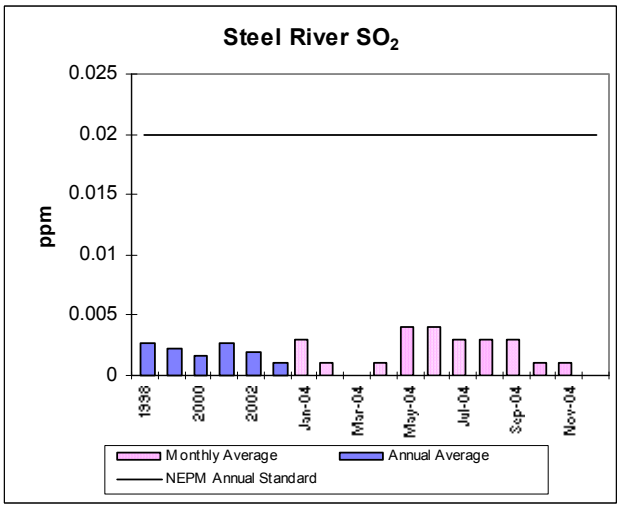
An exceedence of the NEPM standard for PM_{10} occurs when the level monitored is above 50µg/m^3 for the monitoring period. The data in Table 3 shows the reduction in exceedences of PM_{10} as monitored at the Mayfield and Stockton monitoring stations operated by Newcastle Council. This again demonstrates the change to fine particulate levels following the closure of Newcastle Steelworks.



Graph 3: $PM_{2.5}$ Mayfield Ambient Air Monitoring Station

The NEPM advisory standard for $PM_{2.5}$ is 8µg/m^3 measured as an annual average. Graph 3 shows data collected through the ANSTO Aerosol Sampling Project (ASP) that Newcastle Council has supported since 1999. Peaks in measured levels typically occur in summer (bushfires) and winter (woodsmoke) as demonstrated in Graph 3.

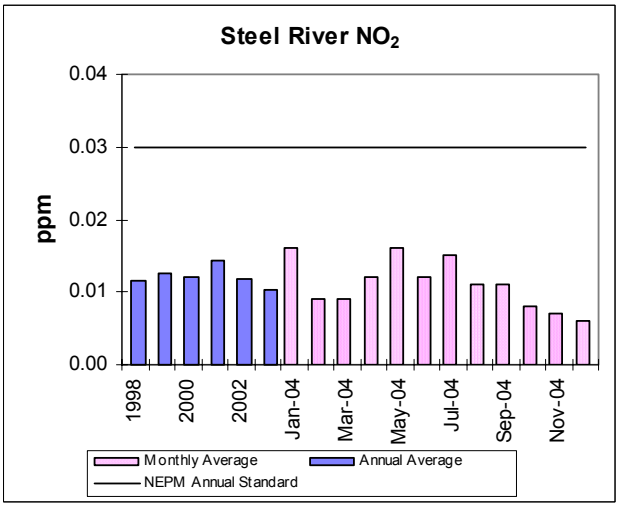
The NEPM standard for SO_2 is 0.02 parts per million measured as an annual average. This level is set as the limit for long term exposure.



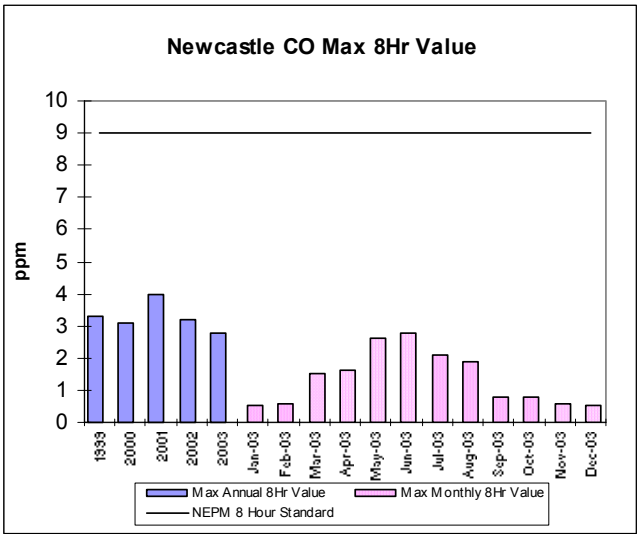
Graph 4: SO_2 Steel River Ambient Air Monitoring Station

Graph 4 shows that the levels of sulphur dioxide monitored at the Steel River monitoring station are significantly below the annual Ambient Air Quality NEPM standards.

The NEPM standard for nitrogen dioxide is 0.12 parts per million measured as a one hour average and 0.03 parts per million measured as an annual average. NSW set out their "Action for Air" interim goals as 0.125 ppm (one-hour average) and 0.03 ppm (annual average) for nitrogen dioxide. These goals were set to take into consideration the effect of nitrogen dioxide on the most sensitive receptors within the community (asthmatics).



Graph 5: NO_2 Steel River Ambient Air Monitoring Station



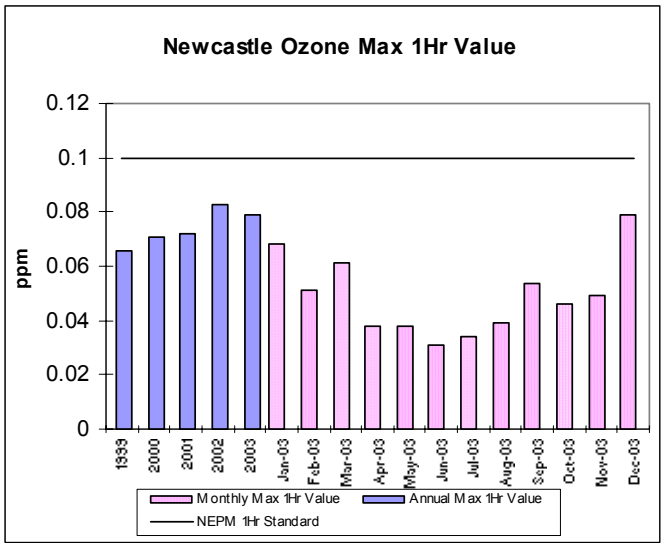
Graph 6: CO Newcastle Ambient Air Monitoring Station

Graph 5 demonstrates that levels of nitrogen dioxide in Newcastle as measured at Steel River are well below the NEPM standard.

The NEPM standard for carbon monoxide (CO) is set at 9.0 parts per million measured as an 8 hour average. This guideline level is set based on the assumption that human health is unlikely to be affected by these levels of ambient carbon monoxide concentrations.

Carbon monoxide levels monitored at the Department of Environment and Conservation (DEC) Newcastle ambient air monitoring station (off Dumaresq Street) are well below the Ambient Air Quality NEPM standard as demonstrated by Graph 6.

The NEPM goal for ozone is 0.1 parts per million based on a 1 hour averaging period. This goal was selected based on providing health protection for a majority of the population including susceptible groups.



Graph 7: O_3 Newcastle Ambient Air Monitoring Station

The 1-hour standard was approached at the DEC Newcastle Monitoring station during January and December 2002 when existing levels from daily emissions from motor vehicles were supplemented by emissions associated with bushfires leading to a number of ozone events. This is demonstrated in Graph 7 by the annual maximum 1 hour value for the year 2002.

5.1. Summary of Ambient Air Quality

The data presented show that Newcastle is achieving compliance with the Ambient Air Quality NEPM goals as set by the National Environment Protection Council for all key pollutants. The pollutants ozone (O_3) and fine particulate (PM_{10}) show levels approaching and sometimes exceeding Ambient Air Quality Standards. Extraordinary natural events such as bushfires and dust storms, influenced by the severe drought experienced throughout NSW in recent years, have influenced observed particulate pollution events. These events are on a daily level that is not displayed in the annual/monthly data presented in Graphs 1 and 2 although severe events are represented as exceedences in Table 3. The levels of carbon monoxide, nitrogen dioxide and sulphur dioxide continue to be well below NEPM Ambient Air Quality standards as demonstrated by Graphs 4 to 7. Ozone is one pollutant where the 1 hour maximum value does approach the NEPM goal. This is indicative of observed increases of ozone levels in large population centres and is due to the increased number of motor vehicles and distances travelled by these vehicles.

6. Air Quality Management Framework

6.1. Establishing Priorities

The key areas of focus for the NAMAP review were identified in the recommendations in the NEMP 2003, and have been confirmed following the preparation of the Newcastle Air Emission Inventory and a review of historical ambient air monitoring data. Analysis of modelling conducted on the airshed suggests a localised impact from air pollutants generated in Newcastle. The areas of focus identified in the inventory were motor vehicles and industry for most pollutants, and domestic wood heaters with respect to the emission of fine particulates. Other domestic, commercial and mobile sources (eg lawn mowers, service stations, rail and shipping) also contribute to the total emissions load in the region.

Review of the actions from the NAMAP 1998 covered an extensive list of actions, which covered areas of responsibility from a number of agencies. The list of actions provided guidance in terms of developing programs and projects however, the action list was subject to funding and resource constraints as well as changing priorities. With just over 50% or 118 actions implemented it was considered time to revise the action plan.

The NEMP 2003 reinforced the need for Council to continue to play a strong local government leadership and advocacy role. This requires Council to consider the management of its operations that impact upon air quality and to lead the way in achieving improvements in air quality.

6.2. Identifying Strategic Actions

The NEMP 2003 identified that effective air quality management requires a range of actions from the strategic level through to the small scale specific actions for a range of air pollution sources. Individuals, households, communities, business, industry and governments all play a significant role in air quality management through their separate and collective actions. The NEMP 2003 identified the following actions as the most important to the Newcastle region.

- Integrate emission data into land use planning,
- Facilitate review and expansion of air monitoring and modelling,
- Undertake Development Compliance for non-scheduled industry,
- Incorporate air quality input into Fleet Management decision making,
- Incorporate air quality input into Council operations,
- Deliver community education programs that are aimed at improving air quality, and
- Research trends and changing technology for incorporation into Council programs.

6.3. Implementing Strategic Actions

Individual actions are subject to resourcing and consideration in Council's management plan and budget process. Indicative timeframes have been provided in the Action Plan. Implementation of individual actions will be coordinated using "Theme Teams" developed through the NEMP to implement actions where environmental themes and organisational processes are linked across discipline boundaries.

6.4. Measuring Performance

The NAMAP will be subject to ongoing monitoring and review. To ensure the aims of the NAMAP are being achieved, it will be critical to evaluate the effectiveness of all actions to improve air quality, and to revise or add to these as necessary.

In order to measure the successful implementation of the NAMAP the actions proposed would be assessed based on:

- their performance against the specific performance measure nominated, and
- community feedback on the proposed actions with respect to community aspirations for air quality and other environmental goals.

Based on the continuous improvement approach of the NEMP 2003 the same approach has been taken to ensure the NAMAP is updated in response to:

- changes in community expectations regarding air quality as measured in Councils annual Community Survey,
- new regulations and National Environmental Protection Measures (NEPM),
- new research regarding air pollution and its effects,
- new methods for measuring air quality in response to research, and
- technological improvements that provide opportunities to improve the management of emissions.

Information obtained from the performance review process will provide input to the future development of actions to continuously improve the air quality of Newcastle in line with the aims of the NAMAP.

6.5. Reporting

Reporting on the progress of the NAMAP will be through the existing reporting mechanisms used by Council. The mechanisms used to report to all stakeholders will be:

- Routine reporting through Council's Environmental Protection and Pollution Advisory Committee
- State of the Environment reporting and
- Newcastle Council web site for Air Quality www.ncc.nsw.gov.au/services/environment/airquality/index.cfm

6.6. Consultation

Newcastle City Council has an established Consultation Policy. This policy provides the framework for the consultation process adopted to carry out the review of the Newcastle Airshed Management Action Plan.

Specifically the following values were taken into account when preparing the consultation process:

- To be open and accessible,
- Ensure community participation in decision making processes, and
- Listen to and share ideas, knowledge and experience.

The consultation process followed in the review of the NAMAP is outlined below.

- Review of existing NAMAP 1998: *A review was one of the key actions listed in the NEMP 2003.*
- Evaluation of progress of existing NAMAP: *The evaluation of the action plans revealed that of the 226 actions listed in the 11 key areas there was an implementation rate of just over 50%.*
- Presentation to Steering Committee – Council staff with responsibilities linked to the NAMAP: *This presentation enabled an overview of progress of NAMAP 1998 action plans and their implementation levels.*
- Feedback from Steering Committee to develop a consensus of direction and guidelines for review. *The consensus from the steering committee was a determination to focus future action to those that Council can implement or influence and address the areas that currently pressure the air quality of Newcastle.*
- Presentation of draft NAMAP to Council's Environmental Protection and Pollution Advisory Committee (EPAPAC) for discussion and review, *EPAPAC accepted the review as good for the future of air quality in Newcastle.*
- Report and draft NAMAP to Council for exhibition,
- Revision and adoption of revised NAMAP following exhibition.

7. Actions

NAMAP 1998 demonstrated that air quality management is influenced by a variety of diverse sources. These sources included individuals, households, communities, business, industry and governments that each plays a significant role in air quality management. Each layer of government was shown to have a role in managing air quality through policies, management strategies, legislation and regulation. A review of the actions of NAMAP 1998 showed that just over 50% of the actions were implemented (see Appendix 2). The highest levels of implementation were in the key issues “Improving energy efficiency”, “Managing air quality issues with small and medium enterprises”, and “Enhancing air quality management of NCC activities”. The lowest levels of implementation were in the key issues of "Monitoring air quality", “Reducing the impact of solid fuel heaters and open fireplaces” and "Reducing the growth in Vehicle Kilometres Travelled".

The actions implemented along with the changed nature of industry in Newcastle have led to significant improvement in air quality in all key pollutant indicators. However there needs to be a continuous focus on air quality improvements and the following key areas have been addressed in the Action Plan (see Appendix 1).

The actions were developed under nine strategic areas. These were selected to reflect key response areas, Newcastle Council’s responsibilities as well as Council’s leading role in air quality management.

7.1. Council Operations

Council is recognised as a leader in air quality management and provides examples of good business practices that reduces the emission of air pollutants. As a major employer and provider of services within the Newcastle LGA, Council operations will be managed to minimise impact upon air quality.

7.2. Energy Efficiency

Council provides leadership and guidance in the improvement of energy efficiency in council operations, as well as the residential and business sectors in the broader community. The Greenhouse Action In Newcastle (GAIN) plan 2001-2008 sets out a series of 88 actions for implementation across all sectors of the community. The GAIN plan focuses on acting locally to minimise our impact on the environment particularly in the area of global warming. The GAIN plan actions target improvements in the areas of energy efficiency, waste minimisation and water conservation. These actions will have complimentary benefits for air quality.

7.3. Regional Cooperation

The Newcastle regional airshed is also influenced by air pollutants transported from both the Sydney basin and the Hunter region. For this reason it is important to have a regional approach to address air quality issues. Newcastle Council's role will be to provide leadership across the region.

7.4. Land Use Planning

Land use planning plays an important role in determining local and regional air quality. The locations of industrial and commercial zoning and the types of industries approved in these zones together with transport corridors was shown in the Newcastle Air Emission Inventory to influence the pollutant loading in these areas. Modelling of the results of the Inventory as shown in Figures 12 & 13 demonstrates the worst case maximum concentrations of particulates (such as PM_{10}) highlighting the interface between different land use zones.

The Newcastle Urban Strategy has the aim "to provide greater choices to the community, in term of access to housing, employment, transport, and social and cultural services, while offering reduced travel demand, improved air quality and greater identity for Newcastle, its city centre, and its district and neighbourhood centres". This strategy provides the long-term guide for future planning and development activities in Newcastle.

7.5. Transport

The Newcastle Air Emission Inventory has identified regional transport networks as a major contributor to air pollution. Increasing tonnages shipped from the port of Newcastle and associated rail and vehicle movements suggest transport related pollution will correspondingly increase unless addressed.

7.6. Vehicle Emissions

Motor vehicles were identified in the Newcastle Air Emission Inventory as a major emission source for most of the criteria pollutants within the Newcastle airshed. Increasing numbers of registered motor vehicles and associated vehicle kilometres travelled

suggest motor vehicle related pollution will continue to increase unless addressed.

As vehicles are a major source of air emissions the actions proposed are to enhance the use of alternate transport strategies to reduce the reliance upon motor vehicles and reduce their impact upon air quality.

7.7. Business & Industry

Although not as significant as in the past, emissions from industry are still a major influence on air quality within the Newcastle airshed. As detailed in Section 5 the quality of Newcastle's air is good and the communities perception is of clean and clear air. However fine particulates (PM_{10}) sometimes approach the recommended limits for good air quality with industry the main source of these air pollutants.

7.8. Regulation & Enforcement

Regulation and enforcement is often a last resort tool to manage the air quality of Newcastle. Particulate pollution has been the main area requiring enforcement in the past.

Legislative tools used to protect Newcastle's air quality include prevention notice where activities are being carried out in an environmentally unsatisfactory manner through to prosecutions for serious environmental incidents.

7.9. Community Involvement

Community based support for the Newcastle Airshed Management Action Plan is critical to its successful implementation. Consulting and involving the community on air quality issues, programs and actions will enable the community to be better informed on all aspects of air quality management. Particulate pollution from a variety of sources has consistently been one of the major causes of community complaints to Council.

The involvement of the community will provide a framework for the community to participate in the achievement of improving air quality in Newcastle and beyond.

8. Glossary

Air pollution
Air pollution is the emission into the atmosphere of substances, which lower air quality. It can have local (approx. 5 km from the source), regional (approx. 50 km or more), or global implications.

Air quality
The condition of the air we breathe.

Airshed
The three dimensional atmosphere above a defined geographical area requiring unified management for achieving air pollution control.

Air toxics
A number of airborne chemical compounds which may have adverse effects on human health even when they are present in very small amounts.

Ambient air
The surrounding air.

Area based source
A collection of a large number of emission points which are either too small or too numerous to identify as individual point sources in an emissions inventory. Area sources encompass a more widespread source that may be abundant, but that individually releases small amounts of a given pollutant.

Aromatics
Chemical classification relating to the structure of hydrocarbon – carbon atoms arranged in rings with some electrons shared over the whole ring, eg. Naphthalene and benzene.

Clean Car Benchmark
A NSW initiative that establishes benchmarks for the categorising of the environmental performance of light vehicles. It incorporates two components in Greenhouse emissions and Noxious pollutants.

Emissions
Substances being released into the environment.

Emissions inventory
A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community.

Emissions sources
Activities or processes which can lead to the release of a pollutant to the air.

Fossil fuels
Fuels derived from fossilised organic matter such as coal, oil and petroleum.

Fugitive emissions
Substances that escape to air from a source not associated with a specific process but scattered throughout the plant, eg. leaks from equipment, dust blown from stockpiles.

Greenhouse Gases
Naturally occurring greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, and ozone. Certain human activities, however, add to the levels of most of these naturally occurring gases. Very powerful greenhouse gases that are not naturally occurring include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6), which are generated in a variety of industrial processes.

Hydrocarbons
Substances composed of only carbon and hydrogen.

Inventory
A detailed, complete list.

Meteorology
The science that deals with the study of the atmosphere (or weather) and its phenomena, especially with weather and weather forecasting.

Mobile source
A source of wastes which is in motion during its normal operating mode.

National Environment Protection Measure (NEPM)
A legal instrument that sets agreed national objectives for protecting particular aspects of the environment.

Organic
Chemicals containing carbon-carbon bonds.

Oxides of nitrogen (NOx)
NOx includes nitrogen dioxide (NO_2) and nitric oxide (NO). NO_2 is the second major acid in acid rain, and is recognised as a major precursor in the formation of photochemical smog.

Ozone
Ozone is a form of oxygen with three atoms in each molecule (O_3).

Photochemical reactions
Chemical reactions that occur in the presence of sunlight

Photochemical Smog
A toxic mixture of air pollutants created through reactions in the atmosphere, mainly between NOx and VOCs in the presence of sunlight. Ozone comprises 80% of photochemical smog in urban atmospheres in Australia.

$PM_{2.5}$
Particles less than 2.5 micrometres in diameter. This fraction of particulate matter penetrates most deeply into the lungs.

PM_{10}
Particles less than 10 micrometres in diameter. These particles are also known as "respirable particles".

Point sources
Large, stationary, identifiable sources of emissions that release pollutants into the atmosphere. Sources are often defined by state or local air regulatory agencies as point sources when they annually emit more than a specified amount of a given pollutant, and how state and local agencies define point sources can vary. Point sources are typically large manufacturing or production plants. They typically include both confined stack emission points as well as individual unconfined fugitive emission sources. Within a given point source, there may be several emission points that make up the point source. Emissions point refers to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterisation of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

Pollutant
A chemical that may reduce the quality if the environment.

Polycyclic Aromatic Hydrocarbons (PAH):
A generic name for a broad group of compounds, all of which have condensed benzene rings (hexagonal rings joined along common sides). Naphthalene is the simplest PAH. PAHs are, and have been historically, ubiquitous in the environment. They occur in smoke from burning wood and vegetation, from fossil fuel combustion and on burnt meat. They are present in much higher concentrations when a wood or coal fire is starved of adequate air or the petrol or diesel engine is emitting smoke. They are usually adsorbed onto particles in the smoke from the above sources.

Smog
The word "smog" was initially formed from smoke and fog to describe airborne pollution. Smog is often used to refer to photochemical pollution.

Solvent
A substance that dissolves or dilutes another.

Stack emissions
Emissions to the atmosphere from a factory chimney or stack.

Substance
Any natural or artificial entity, composite material, mixture or formulation, other than an article.

TSP
Total suspended particulates.

Volatile Organic Compounds (VOC)
A large and diverse group of chemicals, including hydrocarbons, oxygenates and halocarbons (eg. 1,3-butadiene formaldehyde and benzene) that readily evaporate at room temperature. They are a precursor to ozone formation.

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10. Appendices

1 NAMAP action plans

2 Results of review of NAMAP 1998

Appendix 1

NAMAP action plans

Strategic Area	Actions	Comments	Time frame	Performance Measure	Responsibility	Linkages
Council Operations		***To provide a corporate example to other organisations and the general community.***				
CO1	Prepare an inventory of all of Council's operations to ascertain the potential impact upon air quality and monitor progress to reducing this impact.	The improvement of councils operations cannot be quantified until the potential impact of Councils operations are quantified.	Short Term	Inventory prepared	Environmental Services	AMEIF
CO2	Newcastle Council's Carshare program (car pooling and green travel rewards program) to be invigorated to promote the benefits of reduced car travel within NCC.	Program to be refreshed and expanded.	Short Term	VKT saved	Environmental Services	VE1 GAIN Transport 4
CO3	Audit NCC staff travel requirements and use results to identify ways of reducing current motor vehicle use.		Mid Term	Audit completed	Environmental Services	
CO4	Investigate and implement subsidies for staff to travel on public transport.		Mid Term	Subsidies investigated/implemented	City Strategy Human Resources	GAIN Transport 8 Environmental Services
CO5	Implementation of relevant NSW DEC Local Air Improvement Programs as released and incorporate into NAMAP.		Ongoing	Implementation of relevant programs	Environmental Services	
CO6	An accounting system to be investigated to measure Newcastle Council's Carbon sequestration through tree planting to offset Newcastle Council's Greenhouse Gas emissions.		Mid Term	Accounting system investigated	Environmental Services	Landscape, Community Greening
CO7	Investigate the feasibility of the new category of "Improvements to Air Quality" in the Newcastle Environmental Achievement Awards.	This aims to increase recognition of Industry, Business and Community and for achievements in the reduction of air pollution.	Mid Term	Category promoted	Community Partnerships	Environmental Services
CO8	Undertake continuous improvement of the existing NCC air quality monitoring network.	The air quality monitoring network contributes valuable data to assist in the assessment of air quality.	Ongoing	Air quality monitoring network maintained and reviewed	Environmental Services	Business & Industry
Energy Efficiency		***Council pursuing its energy efficiency strategy that reduces the demand for fossil fuels and electricity consumption.***				
EE1	Support the GAIN Plan implementation that includes the focus areas of electricity, natural gas, transport, street lighting, waste, vegetation and water.	Ongoing implementation of this successful and recognised program to reduce Greenhouse Emissions in the Newcastle Council area.	Ongoing	Support provided by Environmental Services and others as required	AMEIF	Environmental Services
Regional Cooperation		***Regional air quality improvements will be most effective if complimentary actions are taken by responsible authorities throughout the airshed.***				
RC1	Promote regional airshed management issues by consultation and promotion with other Lower hunter organisations.		Mid Term	Appropriate promotion through networks.	Environmental Services	REMS
RC2	Update of the Newcastle Air Emission Inventory to be used as a base for modelling in the assessment of major development and comparison with existing Inventory.	The accuracy of any air emission model for Newcastle region is reliant upon the base information provided for the airshed by the Newcastle Air Emission Inventory.	Mid Term	Revised at regular intervals, as new data becomes available ie. (census data, business survey etc)	Environmental Services	NSW DEC

Strategic Area	Actions	Comments	Time frame	Performance Measure	Responsibility	Linkages
Land Use Planning		***Appropriate land use planning is critical to reducing transport related emission and progressing towards improved air quality for Newcastle.***				
LU1	Carry out appropriate assessment and institute controls (conditions) through the Development Application process.		Ongoing	Best Practice Conditions applied	Development & Environment	
LU2	Implement the Newcastle Urban Strategy	Promotes an urban form, which provides greater choices to the community while offering improved air quality for Newcastle.	Long Term	Urban Strategy actions implemented	City Strategy	Development & Environment
Transport		***Encourage the alteration of community preferences in transport modes towards modes with lower emissions.***				
T1	Investigate and promote alternative lower emission transport strategies.	Alternatives can be carsharing, cycling, walking and the use of public transport.	Mid Term	Alternative strategies promoted.	City Strategy	Environmental Services Education
T2	Enhance and extend the Bicycle network throughout the Newcastle Local Government Area.	Existing plans "NCC Bicycle Plan", "Newcastle and Lake Macquarie Bike Plan"	Mid Term	Bike plans implemented	Infrastructure Development	
T3	Promote regional transport plans that enhance the use of public transport and reduce the reliance upon motor vehicles within the Newcastle area.	The existing plan "Sustainable Transport in the Lower Hunter Region" to be supported	Ongoing	Support of existing plans that promote the use of public transport.	City Strategy	
Vehicle Emissions		***Council by leading through example, can influence motor vehicle owners to adopt practices to reduce motor vehicle emissions.***				
VE1	Promote Newcastle Council's carshare/carpool program to other businesses and industries throughout the region	Extend this Council initiative to major employers and institutions throughout the Newcastle area.	Short Term	Support to organisations adopting Carshare program	Environmental Services	
VE2	Include motor vehicle emission performance as a consideration in the purchase of Newcastle Council fleet vehicles.	NCC fleet should consider air quality issues when purchasing fleet vehicles	Mid Term	Emission performance a consideration in purchase of vehicle.	Fleet Operations	Corporate Services
VE3	Measure the performance of Newcastle Council's light vehicle fleet against the NSW Clean Car benchmarks.	The clean car rating is the first step of the NSW Cleaner Vehicles Action Plan to establish benchmarks for categorising environmental performance of light vehicles.	Mid Term	Benchmark rating for NCC fleet completed.	Environmental Services	
VE4	Alternative fuels to be investigated and promoted where applicable.		Short Term	Alternative fuels use promoted	Purchasing AMEIF	Fleet Management

Strategic Area	Actions	Comments	Time frame	Performance Measure	Responsibility	Linkages
Business & Industry		***Business and industry involvement in reduction of emissions and long term air quality management.***				
BI1	A component of Council's Business Pollution Prevention Program that consists of pro-active site inspections and assessments of industrial and commercial premises to focus on premises with a high potential for air emissions.	This will target the premises with a high potential to impact upon air quality	Ongoing	No of site inspections and assessments completed	Environmental Services	
BI2	Promote the preparation of Environmental Management Plans to minimise emissions from new and existing industries and businesses.	Focus to be on industries and businesses which have the potential for air quality impacts	Ongoing	Environmental Management Plans promoted in businesses inspected under BPPP	AMEIF Environmental Services	
BI3	Recommend to relevant approval bodies that cumulative assessment of air emissions to be conducted as part of the development process for major industries.	Results from the Air Emission Inventory are being incorporated in a model to be run by the DEC.	Short Term	Appropriate recommendations made on major industrial development	NCC DEC DIPNR	
Enforcement & Regulation		***Action the community expectations of enforcement of air quality standards.***				
ER1	Undertake regulatory action as required under the POEO Act 1997.	Enforcement of environmental legislation where the offence is so severe or blatant as to warrant action.	Ongoing	Number of actions	Environmental Services	
Community Involvement		***Increase public awareness of air quality issues and encourage community action to improve air quality.***				
C1	Provide air quality information on the Newcastle Council web site to display timely, informative information on air quality in Newcastle.		Ongoing	Available information updated on regular basis	Environmental Services	
C2	Encourage local events that promote clean air - Walk to Work Day 1st Oct, Clean Air Day, National Tree Day 25th July and Active Australia Day.	Awareness of National and State wide promotions to promote walking and cycling to encourage participation at local level.	Ongoing	Local events promoted	Community Partnerships	Environmental Services
C3	Develop an ongoing program to consult with the community in the implementation of the NAMAP.	A core issue for the NAMAP is for the community to be involved and informed of the issues surrounding air quality.	Ongoing	Appropriate and interested parties consulted and involved	Environmental Services	Community Partnerships
C4	Report on progress of NAMAP to the community on a regular basis.	Use the State of Environment Report and NCC web site to report to community on progress on NAMAP.	Ongoing	Regular updates of Web Site and SOE Report Clean and Green News	Environmental Services	Community Partnerships
C5	Continue Woodsmoke reduction program, consisting of education, advice and enforcement prior to the start of winter.	Survey, education and enforcement program to be implemented in the winter "woodsmoke season".	Ongoing	Woodsmoke reduction program conducted.	Environmental Services	
C6	Continue interaction and feedback through Council's Environmental Protection and Pollution Advisory Committee (EPAPAC).	EPAPAC has Council officers, Councillors, Hunter Area Health, Clean Air Society of Australia and New Zealand, residents groups and environmental officers from local industry as well as other government agencies such as DEC when specific issues arise.	Ongoing	Feedback provided on progress of NAMAP	Environmental Services	

Appendix 2

Review of NAMAP 1998

NAMAP 1998 Review

Summary of action plans progress

Key Issues	Number of plans	Number Actioned	% Actioned
Minimising Industrial Emissions	36	18	50%
Reducing the growth in Vehicle Kilometres Travelled	27	8	30%
Improving energy efficiency	31	20	65%
Managing air quality issues with small and medium enterprises	28	16	57%
Reducing the impact of solid fuel heaters and open fireplaces	11	5	45%
Enhancing air quality management of NCC activities	24	13	54%
Making motors run cleaner	15	8	53%
Reducing emissions from Residential Premises	17	11	65%
Monitoring air quality	8	4	50%
Developing better solutions	29	15	52%
	226	118	52%

There were a total of 226 actions listed in the 10 key issues in NAMAP 1998. Newcastle Council was only directly responsible for 33 out of the 199 actions (27 were duplicated throughout different key issues) and played a role in another 100. Many of the actions where Council had involvement were described as an “advocacy role”. Many of the actions listed were the responsibility of State Government departments or government controlled organisations.

Key issues where Newcastle Council had influence or were directly responsible were more likely to be actioned (eg Improving energy efficiency, Managing air quality issues with small and medium enterprises, and Enhancing air quality management of NCC activities).