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2003 Annual Air Quality Monitoring Report for the Wellington Region

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Contents

Executive Summary

The Annual Air Quality Monitoring Report 2003 presents the results of ambient air quality monitoring that has been carried out in the Wellington Region during the year ending 30 September 2003. Ambient air quality monitoring was undertaken at Upper Hutt, Lower Hutt, Masterton and Wainuiomata.

The contaminants that have been monitored in the Wellington Region over the past year include fine particulate matter (PM_{10}), carbon monoxide (CO), and nitrogen dioxide (NO_2). These pollutants are known to adversely affect human health and well-being, as well as to have other adverse environmental effects. Air quality monitoring has focused on these pollutants as they are discharged to the atmosphere in the greatest quantities from a variety of sources.

Figure 1 provides a graphical illustration of the ambient air quality monitoring results compared with air quality guidelines intended to protect human health.

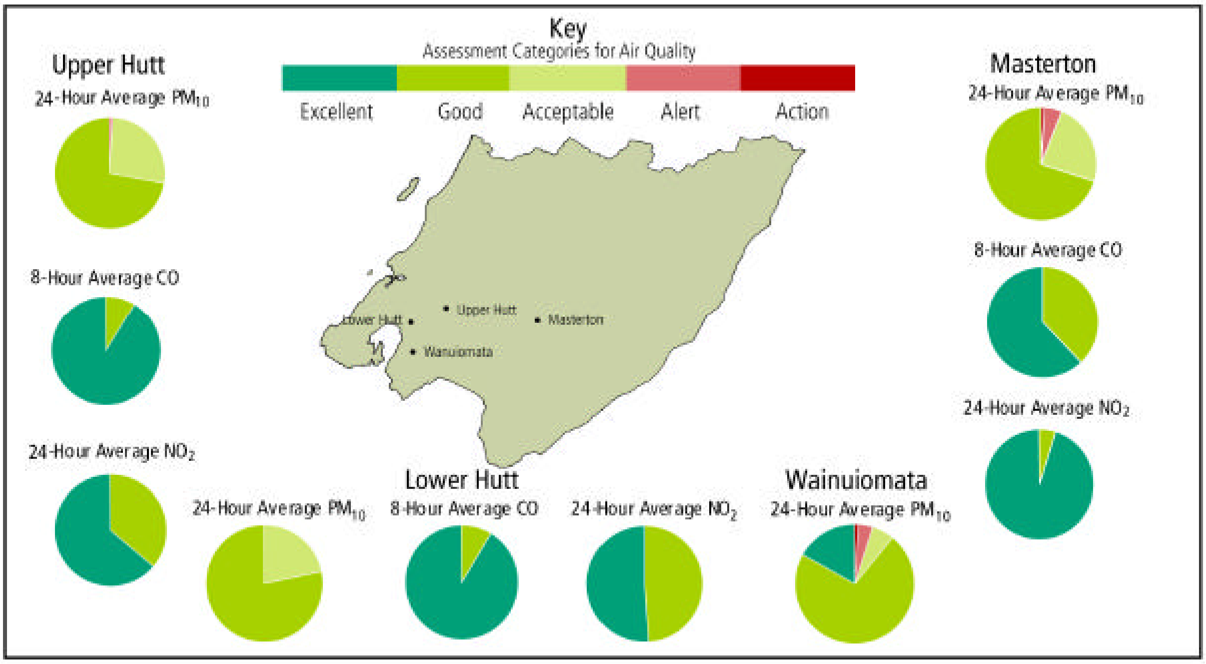


Figure 1: Air quality monitoring results for the Wellington Region

Upper Hutt

A mobile ambient air quality monitoring station has been located at Trentham Fire Station in Upper Hutt since June 2000. The monitoring data confirms that the Upper Hutt area continues to be susceptible to wintertime pollution episodes.

There were no exceedences of the National Ambient Air Quality Guidelines during the last year. Particulate matter, carbon monoxide and nitrogen dioxide concentrations were found to be higher during the winter. It is thought that domestic fires are the main cause of the particulate pollution and a combination of motor vehicles and domestic fires are responsible for the elevated levels of carbon monoxide and nitrogen dioxide.

Lower Hutt

The Council's first permanent ambient air quality monitoring station has been operating at Birch Lane in Lower Hutt since February 2001.

The results indicate that nitrogen dioxide levels were elevated during the winter in Lower Hutt. This is likely to be due to the combined effect of motor vehicle emissions and combustion emissions from residential and commercial heating combined with cold calm meteorological conditions. Peak levels occurred at similar times as those recorded at Upper Hutt, indicating the predominant influence of the weather on air pollution levels.

Wainuiomata

PM_{10} was monitored at Wainuiomata Bowling Club from October 2002 through to October 2003. Fine particulate concentrations exceeded the National Ambient Air Quality Guideline on one occasion during the past winter. Peaks in air pollution occurred during cold calm weather conditions when dispersion of air pollutants was poor.

Wainuiomata continues to be susceptible to air pollution events during the winter and Greater Wellington will continue to monitor fine particles at the current site and is also looking to establish a meteorological site in the valley for air pollution studies. The use of solid fuel fires for domestic heating is thought to be the main source of air pollution in Wainuiomata.

Masterton

A permanent ambient air quality monitoring station was established at Wairarapa College in Masterton during October 2002. The highest air pollution levels in Masterton were recorded during winter with three exceedences of the National Ambient Air Quality Guideline for particulate matter (PM_{10}). Similar to Wainuiomata, the cause of the high particulate matter concentrations is likely to be emissions from domestic solid fuel fires.

Conclusion

The results of the ambient air quality monitoring carried out in the Wellington Region over the past year have indicated that the highest concentrations of air pollutants occurred during the winter. The higher winter time air pollution levels are the consequence of periods of cold, calm weather and a greater quantity of emissions to atmosphere from combustion sources. Cool, calm conditions restrict the dispersion of air pollutants. The major pollution sources are most likely to be motor vehicles and domestic solid fuel fires.

Ambient air quality monitoring at various locations within the Wellington Region shows that air quality is generally good during the summer months at suburban locations. However, at times, certain areas experience degraded air quality due to a combination of meteorological conditions and local emission sources exerting pressure on the air resource to the extent that it may pose a risk to the health of local populations. With the establishment of a permanent air quality monitoring network, clear trends in air pollution levels are becoming evident. Winter is the most likely time for pollution episodes to occur, the severity of which are entirely dependent on the type of winter we experience.

There is ample international medical and epidemiological evidence that once air pollution levels start approaching guideline levels there are tangible and potentially serious health consequences for the community. The most affected are sensitive sub-populations such as the very young, the old and those predisposed to respiratory and cardiopulmonary disorders. The Region's communities do not have any choice in the air that they breathe.

The two major sources of air pollutants in the Region, motor vehicles and domestic solid fuel fires are permitted as of right in the Regional Air Quality Management Plan for the Wellington Region. The Plan may need to be amended to reflect the true nature of our air quality issues and provide consistency with the National Environmental Standards for Air Quality when they are released.

1. Introduction

This Annual Air Quality Monitoring Report 2003 reports on all ambient air quality monitoring that has been carried out in the Wellington Region for the year ending 30 September 2003. Ambient air quality is the general quality of the air that surrounds us. Ambient air quality reflects the cumulative effects of discharges to the atmosphere from both human activities and natural sources.

Greater Wellington (the Council) has the responsibility to monitor the state of the environment pursuant to section 35 of the Resource Management Act 1991. Part of this responsibility includes monitoring ambient air quality.

The Regional Air Quality Management Plan requires the collection of information on particular aspects of air quality so that the effectiveness and appropriateness of policies, objectives and rules can be assessed.

The cumulative effects of emissions from domestic fires, motor vehicles and certain industrial production processes can be evaluated by monitoring the ambient concentrations of key air pollutants. We need information regarding such pollutants to make any management decisions necessary to maintain and enhance air quality within the Region

The Regional Air Quality Management Plan contains Regional Ambient Air Quality Guidelines (see Table 2.1). Air quality within the Wellington Region needs to be monitored in order to assess whether these guidelines are being met. It is important to note that these guideline levels are intended only for the protection of human health based on current medical and scientific knowledge and may not provide adequate protection for the wider environment, such as sensitive ecosystems.

During 2002/2003 an air quality screening survey was undertaken at Upper Hutt. Monitoring of particulate matter (fine dust) was also undertaken at a site in the Wainuiomata basin.

Greater Wellington has now established its second permanent air quality monitoring station at a site in Masterton. The monitoring station will monitor ambient air quality in order to assess trends in air pollution levels and any potential adverse health effects for the population of Masterton.

2. Air quality monitoring

2.1 Monitoring strategy

Ambient air quality monitoring is necessary for assessing many of the issues identified in the Regional Policy Statement and the Regional Air Quality Management Plan. In particular, the relative concentrations of various air pollutants have adverse effects on human health and amenity values.

There is insufficient information and data available to fully characterise the state of ambient air quality (for state of the environment reporting) in the Wellington Region. This was one of the issues identified in the Region's State of the Environment Report "*Measuring Up*" (Wellington Regional Council 1999). A series of air quality screening investigations was undertaken from 1997-2001 in order to prioritise potential sites for permanent air quality monitoring stations. These investigations have identified areas where air quality is, or can intermittently become, degraded to the extent that it may affect human health. It is in these areas that permanent ambient air quality monitoring will be undertaken.

Permanent monitoring stations are required to assess trends in air quality and the state of the resource. At least three years continuous data is necessary before any trends become evident and useful comparisons can be made between sites.

The Wellington Region is divided into a series of airsheds, delineated by valleys in between steep hills or mountains. This produces unique microclimates and meteorological conditions for each of these sub-regional airsheds. Each location has differing pressures on the air quality resource and the resultant effects on air quality cannot be inferred from one site to another. The main airsheds that have been identified as subject to air quality pressures are Wellington City, Lower Hutt Valley, Upper Hutt Valley, Wairarapa Valley, Porirua, Kapiti Coast, Karori and Wainuiomata.

The *Wellington Regional Air Quality Monitoring Strategy 2000-2005* (Resource Investigations Technical Publication WRC/RINV-T-00-20 June 2000) identifies the sites where permanent monitoring stations are appropriate and where further screening investigations need to be undertaken.

Compliance monitoring of specific sources of air pollutants in specific areas forms part of a separate programme. A monitoring strategy for the Petone/Seaview area has been developed for this purpose, the ***Petone-Seaview Ambient Air Quality Monitoring Strategy 2001-2003*** (Resource Investigations Technical Publication WRC/RINV-T-01-40 September 2001).

2.2 Air pollutants monitored

The contaminants that are being monitored in the Wellington Region are particulate matter (PM_{10}), carbon monoxide (CO) and nitrogen oxides (NOx). These air pollutants are three of the air pollutants identified in the Regional Ambient Air Quality Guidelines (reproduced as Table 2.1), the *National*

Ambient Air Quality Guidelines (Ministry for the Environment 1994) and in *Ambient Air Quality Guidelines: 2002 Update* (Ministry for the Environment 2002).

CO, NOx and PM_{10} are national State of the Environment Indicators for air quality. These contaminants have been monitored as they are emitted in the greatest concentrations from a variety of sources throughout the Wellington Region. They were chosen as they are known to have adverse effects for human health and well-being, and to have other adverse environmental effects.

2.2.1 Nitrogen oxides (NOx)

Nitrogen oxides principally consist of nitric oxide (NO) and nitrogen dioxide (NO_2). NO and NO_2 have the potential to cause adverse human health effects and NO_2 contributes to poor visibility. Both compounds form acidic species when in aqueous solution (hence they are a component of acid rain) and can attack the human body's mucous membranes and the respiratory system. Nitrogen dioxide forms a brown gas in the atmosphere and can be seen as a haze over cities during periods of calm weather and heavy traffic congestion (e.g. during *rush hours*).

Sources include:

- Motor vehicles
- Domestic fires
- Industrial combustion processes.

NO_2 is not usually discharged from these sources in significant concentrations, but is more likely to form in the atmosphere by chemical transformation of NO. For the purposes of this report, the monitoring stations were considered to be of sufficient distance away from major local NOx sources for the formation of NO_2 to be representative of general ambient NO_2 concentrations. Only NO_2 has been reported in this document.

2.2.2 Particulate matter (PM_{10})

PM_{10} is that portion of particulate matter with an aerodynamic cross-section less than 10 micrometers. This fine particulate matter is small enough to enter the smaller more vulnerable passages of the respiratory system. The health effects associated with inhalation of fine particulate matter have been established from epidemiological studies overseas. The National Ambient air Quality Guideline for PM_{10} is 50 $\mu g/m^3$ (24-hour average).

An ambient air quality guideline for $PM_{2.5}$ of 25 $\mu g/m^3$ (24-hour average) has been recommended. $PM_{2.5}$ is that portion of particulate matter with an effective aerodynamic cross-section less than 2.5 micrometers. Recent medical research suggests that $PM_{2.5}$ may be a better indicator of potential adverse human health effects. By definition $PM_{2.5}$ is a subset of PM_{10}.

PM_{10} is associated with the following issues in the Wellington Region:

- Adverse human health effects
- Winter time "smog" events
- Reduction in atmospheric visibility (haze)
- Dust nuisance

Sources of PM_{10} include:

- Domestic fires
- Motor vehicles
- Industrial combustion processes
- Quarrying activities
- Natural sources such as sea salt and soil particles

Densely populated residential areas, solid fuel heating appliances, adverse meteorological conditions (inversions), and the dispersion limiting effect of topography can all combine to produce high ambient concentrations of particulate matter.

The ambient air quality monitoring results for PM_{10} at the various sites within the Wellington Region have been assessed in this report using the guideline of 50 $\mu g/m^3$.

2.2.3 Carbon monoxide (CO)

Carbon monoxide is principally a concern because of its potential to replace oxygen molecules in haemoglobin resulting in adverse health effects. CO is produced from the following sources:

- Domestic fires
- Industrial combustion sources
- Motor vehicles

Wellington's main shopping areas are along streets that suffer from traffic congestion. The combination of traffic emissions, complex topography (i.e. streets enclosed by tall buildings) and adverse meteorological conditions, such as evening inversions in the winter, can result in carbon monoxide concentrations rising to levels that may endanger public health.

High carbon monoxide concentrations have also been measured in built up residential areas and, in this case, are usually the result of emissions from motor vehicles and/or domestic fires.

2.3 Ambient air quality guidelines

Regional Ambient Air Quality Guidelines are reproduced in Table 2.1. The Regional Guidelines are based on National Ambient Air Quality Guidelines (Ministry for the Environment 2002).

The National Guidelines and the Regional Maximum Acceptable Level (MAL) Guidelines are recommended only as minimum standards of air quality to protect public health. The guidelines were developed from World Health Organisation Standards and international epidemiological research. They are **not** maximum permissible concentrations of pollutants in air or limits that can be polluted 'up to' safely as the more sensitive members of the population to air pollution may experience adverse health effects below these levels.

The Maximum Desirable Level (MDL) is defined as the level that will provide maximum protection to the environment (including soil, water, flora, fauna, structures, and amenity values), taking into account existing air quality, community expectations, economic implications, and the purpose and principles of the Resource Management Act 1991. Desirable levels are appropriate guidelines or targets in rural or residential areas, and in other areas where good air quality is considered a priority.

The MDL's set in the Regional Ambient Air Quality Guidelines are based on Canadian and World Health Organisation Standards. These guidelines include a factor for the protection of sensitive flora and fauna (ecosystems) as well as human health.

The National Ambient Air Quality Guidelines include guidelines for a range of toxic organic compounds such as benzene and formaldehyde and heavy metals such as mercury and chromium. Some of these toxic pollutants may be of concern at certain locations in the Wellington Region and the Regional Council will consider screening surveys of for these air pollutants in the future.

Table 2.1: Regional and national air quality guidelines

Indicator	Maximum Desirable Level (Regional)	Maximum Acceptable Level (Regional /National)	Averaging Times	Techniques for Measurement
Particulates PM_{10}		50 µg/m³	24 hours	AS3580.9.6-1990
	40 µg/m³	40 µg/m³	Annual	AS3580.9.7-1990
$PM_{2.5}$		25 µg/m³	24 hours	US 40 CFR Part50
Carbon Monoxide		30 mg/m³	1 hour	AS3580.7.1-1992
	6 mg/m³	10 mg/m³	8 hours	AS3580.7.1-1992
Lead		0.2 µg/m³	3 months	AS2800-1985
Nitrogen Dioxide	95 µg/m³	200 µg/m³	1 hour	AS3580.5.1-1995
	30 µg/m³	100 µg/m³	24 hours	
Fluoride	**Special Land Use**			
		1.8 µg/m³	12 hours	AS3580.1.13.1-1993
		1.5 µg/m³	24 hours	AS3580.13.2-1991
		0.8 µg/m³	7 days	
		0.4 µg/m³	30 days	
		0.25 µg/m³	90 days	
	General Land Use			
	1.8 µg/m³	3.7 µg/m³	12 hours	AS3580.13.1-1993
	1.5 µg/m³	2.9 µg/m³	24 hours	AS3580.13.2-1991
	0.8 µg/m³	1.7 µg/m³	7 days	
	0.4 µg/m³	0.84 µg/m³	30 days	
	0.25 µg/m³	0.5 µg/m³	90 days	
	Conservation Areas			
		0.1 µg/m³	90 days	
Hydrogen Sulphide	1 µg/m³	7 µg/m³	30 minutes	AS3580.8.1-1990
Ozone	100 µg/m³	150 µg/m³	1 hour	AS3580.5.1-1993
		100 µg/m³	8 hours	
Sulphur Dioxide		350 µg/m³	1 hour	AS3580.8.1-1990
		120 µg/m³	24 hours	

µg - micrograms
mg - milligrams
AS - Australian Standard

A useful method to illustrate the significance of ambient air quality monitoring results is to depict the percentage of time that the monitoring results fall into certain categories. This method is described by the Ministry for the Environment in the discussion document on Environmental Performance Indicators (Ministry for the Environment, October 1997). Table 2.2 provides a description of these categories.

Table 2.2: Air quality categories

Category	Maximum Measured Value	Comment
Action	Exceeds Guideline	Completely unacceptable by national and international standards.
Alert	Between 66% and 100% of the guideline	A warning level which can lead to guidelines being exceeded if trends are not curbed.
Acceptable	Between 33% and 66% of the guideline	A broad category, where maximum values might be of concern in some sensitive locations, but are generally at a level that does not warrant dramatic action.
Good	Between 10% and 33% of the guideline	Peak measurements in this range are unlikely to affect air quality.
Excellent	Less than 10% of the guideline	Of little concern.

The main intention of the air quality categories is to present the results of ambient monitoring in a manner that assists in setting goals for air quality management. Wellington Regional Council has set the goal that “Air quality throughout the Region is always ‘acceptable’ (i.e. minimal health risk)” as part of its Long Term Council Community Plan.

2.4 National environmental standards for air quality

The Ministry for the Environment is currently in the process of promulgating a series of National Environmental Standards, including standards for Air Quality. National standards have the force of regulation. The standards are presented as a package consisting of:

- **ambient standards** for carbon monoxide (CO), particles (PM_{10}), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and ozone (O_3);
- **prohibitive standards**, which prohibit various activities that discharge unacceptable quantities of contaminants into the air;
- **an emission standard** for the design of small, domestic solid-fuel-burning appliances.

Agencies responsible for managing emissions to air under the Resource Management Act 1991 (RMA) will need to implement policies and rules to achieve the National Standards. The proposed National Environmental Standards aim to:

- create a level playing field across New Zealand;
- provide certainty and consistency;
- guarantee a level of protection for the health of all New Zealanders;
- drive effective regional and national policies to improve air quality.

The proposed National Standards for Air Quality are similar to the national guidelines, except that provision for an ‘allowable’ number of exceedences has been included. The implementation of National Standards will have implications for Greater Wellington. For example;

- all exceedences of the Standard will need to be publicly notified;
- Greater Wellington will be held accountable for non-compliance with the Standard.

The full impact of the proposed Standards on air quality management within the Wellington Region will become evident once the Regulations are promulgated by the Ministry for the Environment.

The ambient air quality monitoring results presented in the following sections have been compared to the National Ambient Air Quality Guidelines or Maximum Acceptable Levels for the protection of human health and categorised using the air quality categories in Table 2.2.. The purpose of this was to reflect how air quality in the Region may perform against the proposed National Environmental Standards for Air Quality.

3. Air quality monitoring technical details

3.1 Mobile ambient air quality monitoring station

The mobile ambient air quality monitoring station is a small (1.8 x 1.8 x 2.4 m high) insulated and air-conditioned shed with a 6 metre meteorological mast and sampling ports. The air-conditioning is maintained at 23-24^{O}C. Figure 3.1 is a photograph of the mobile monitoring station.

Figure 3.1: Mobile air quality monitoring station

3.2 Permanent monitoring stations

3.2.1 Birch Lane, Lower Hutt

Greater Wellington established its first permanent air quality monitoring station at Birch Lane in Lower Hutt. This monitoring station monitors background air quality in order to assess trends in air pollution levels and the exposure risks for the population of the Lower Hutt Valley. Figure 3.2 is a photo of the Birch Lane site.

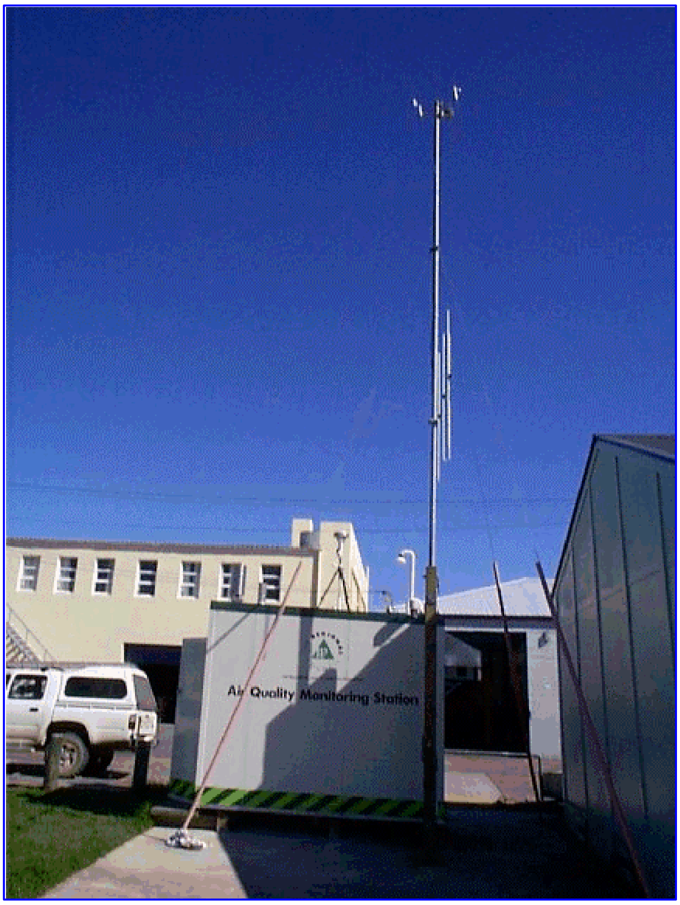


Figure 3.2: Birch Lane air quality monitoring station

The Birch Lane monitoring station houses similar monitoring equipment to the mobile station and the instrumentation is included in the general description section 3.3. The only real difference is that the permanent station is a little larger and the meteorological mast is 10 metres instead of six. Additional parameters monitored are solar radiation (global) and rainfall.

3.2.2 Wairarapa College, Masterton

Greater Wellington has established its second permanent air quality monitoring station at Wairarapa College in Masterton. This monitoring station monitors background air quality and meteorology in order to assess trends in air pollution levels and the exposure risks for the population of Masterton. An air quality screening survey undertaken in 1999-2000 indicated that Masterton was subject to high pollution episodes during the winter. Figure 3.3 is a photo of the Wairarapa College site.

Figure 3.3: Wairarapa College air quality monitoring station

Air pollutants monitored include CO, NOx, and particulate matter. The monitoring station is adjacent to a 15 metre meteorological mast, parameters monitored include wind speed, wind direction, temperature, solar radiation, relative humidity, soil moisture and temperature, and rainfall.

3.3 Monitoring instruments

3.3.1 Nitrogen oxides (NOx)

Nitrogen oxides are continuously monitored using NOx Chemiluminescence Analysers. The instruments have an internal zero air scrubber for zero checks and a NO_2 permeation tube (supplying *ca*. 500 ppb NO_2) for span checks. The sample inlet for the instrument is approximately 3 m above ground level in a rain protected outlet. All NOx data is recorded as parts per billion (ppb).

Only the monitoring results for NO_2 have been assessed in this document, as NO_2 is included in the ambient air quality guidelines. NO is slowly converted to NO_2 in the atmosphere by oxidative processes.

3.3.2 Particulate matter (PM_{10})

PM_{10} is continuously monitored with a Rupprecht & Patashnick Co. Ltd. TEOM Series 1400AB Ambient Particulate Monitor. The TEOM cap, case and air temperatures were set at 40 ^{O}C in line with national ambient air quality monitoring protocols. The TEOM PM_{10} size selective inlet was 3 m above ground level. The instrument is set to record particulate matter concentrations as $\mu g/m^3$ at 0^{O}C and 1 atmosphere pressure. As recommended in the *Good Practice Guide for Air Quality Monitoring and Data Management* (MfE 2000) a high volume sampler has been collocated at the Masterton site since April 2003 in order to provide a baseline comparison.

3.3.3 Carbon monoxide (CO)

Carbon monoxide is continuously monitored using an CO Gas Filter Correlation Infrared Analysers. The instrument has an internal zero air scrubber with a zero air supply for zero checks and a span gas for span checks. Span gas (40 ppm CO) is supplied using BOC Gases Limited β−Grade CO gas. The sample inlets for the instrument are approximately 3 m above ground level alongside the NOx inlet. All CO data is recorded as parts per million (ppm).

3.3.4 Meteorological parameters

A 6 m meteorological mast is attached to the mobile monitoring station and the Birch Lane station has an associated 10 m mast, while the new Masterton station has a 15 m mast. Various meteorological parameters are monitored continuously. Wind speed, wind direction, relative humidity and temperature are all monitored at mast top. Temperature is also monitored at 1.5 m for atmospheric stability assessments. North or 0^{o} for the wind direction indicator is aligned with true north.

3.3.5 Data acquisition

The CO, NOx and TEOM instruments were connected by a digital interface to an Iquest DS 4483 DOLogger datalogger. All logged data was stored as 10 minute averages. Data was downloaded to a central archive four times a day via a radio modem system.

3.3.6 Quality assurance

Greater Wellington Resource Information Section, which collects, checks and archives all the air quality data, is an ISO 9002 registered supplier. The methodologies used for collecting and archiving data, as well as the maintenance schedules and record sheets are all documented, as part of the ISO 9002 registered quality system. The air quality monitoring methods used by the Regional Council are either Australian Standard methods or (in the case of the TEOM) United States EPA designated methods. All maintenance and instrument inspections are carried out as per manufacturers' instructions and recommendations and/or to the appropriate Australian Standard.

All incoming data for the air quality monitoring stations was inspected on a daily basis to ensure that the monitoring instruments were operating within expected parameters. The monitoring stations were visited at least once a week in order to carry out a diagnostics check on all instruments. Site visits and any operations carried out on the monitoring instruments were recorded in a carbon-copy site log book, which are kept at the monitoring stations at all times.

Zero and span calibrations are performed monthly, and three-monthly multipoint calibrations were carried out on the CO and NOx instruments.

The data used in this report has been corrected for zero drift of more than ±2% for CO and NOx. For the purposes of analysis in this report, ppm CO has been converted to mg/m^3 at 0^oC and 101.3 kPa pressure (i.e. mg/m^3 = 1.25 x ppm). NO_2 has been converted from ppb to $\mu g/m^3$ at 0 ^oC and 101.3 kPa pressure (i.e. $\mu g/m^3$ = 2.05 x ppb). All data manipulation and analyses in this report has been performed using Hilltop, a software package designed to store and provide analyses of time dependent data.

3.4 PM_{10} high volume sampler

The high volume particulate sampling utilises a gravimetric method for monitoring PM_{10}. The instrument itself is a Lear Siegler Australasia Pty Limited Flow-Set High Volume Air Sampler. Ambient air is passed through a size selective inlet and then through a pre-weighed conditioned filter that is removed after 24 hours continuous sampling, conditioned and then reweighed. The results are expressed as the 24-hour average for that time period.

This ambient air quality monitoring method is an Australian and USEPA Standard method and the high volume sampler is operated accordingly. Two instruments are currently operated on a one-day-in-three 12:00 pm to 12:00 pm sampling basis. One high volume sampler was located at Wainuiomata Bowling Club from September 2000 through to October 2003 and the other has been co-located alongside the monitoring station at Wairarapa College, Masterton.

Figure 3.4: High volume sampler at Wainuiomata Bowling Club

3.4.1 Quality assurance

The high volume samplers were calibrated on a two-monthly basis using an Orifice Calibration Plate as per AS 3580.9.6-1990. The calibrations showed <3% drift in the flow rates.

4. Monitoring results

4.1 Trentham Fire Station, Upper Hutt

4.1.1 Site description

The monitoring station was located within the grounds of Trentham Fire Station, off Fergusson Road in Upper Hutt (Grid Reference E2681464; N6006446, elevation 40m). Figure 4.1 shows a map of the area and Figure 4.2 details the site layout.

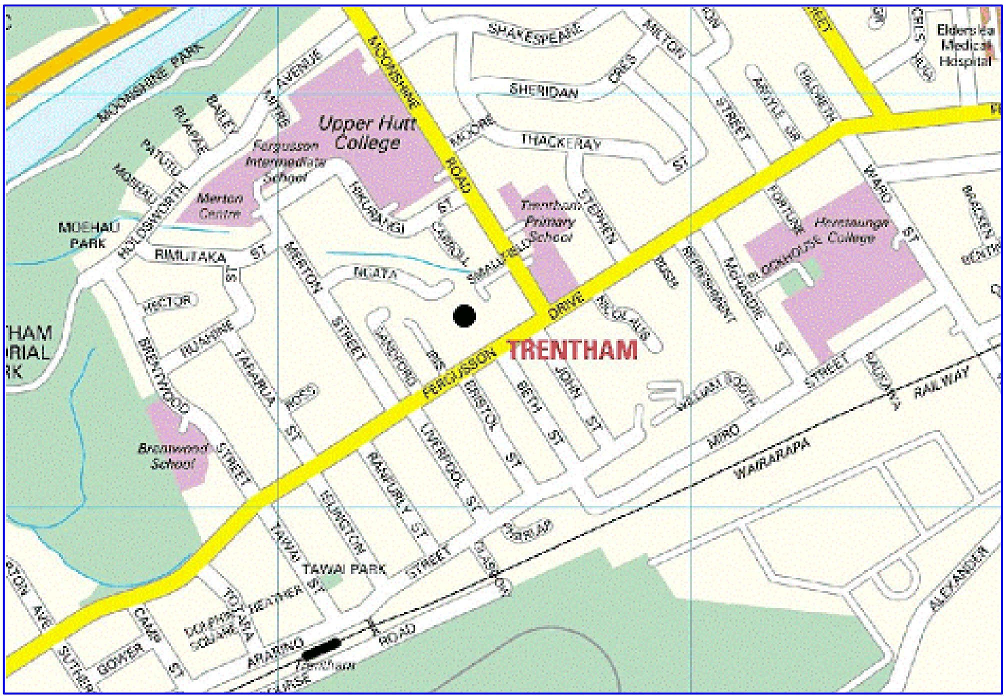


Figure 4.1: Map showing location of monitoring site (●)

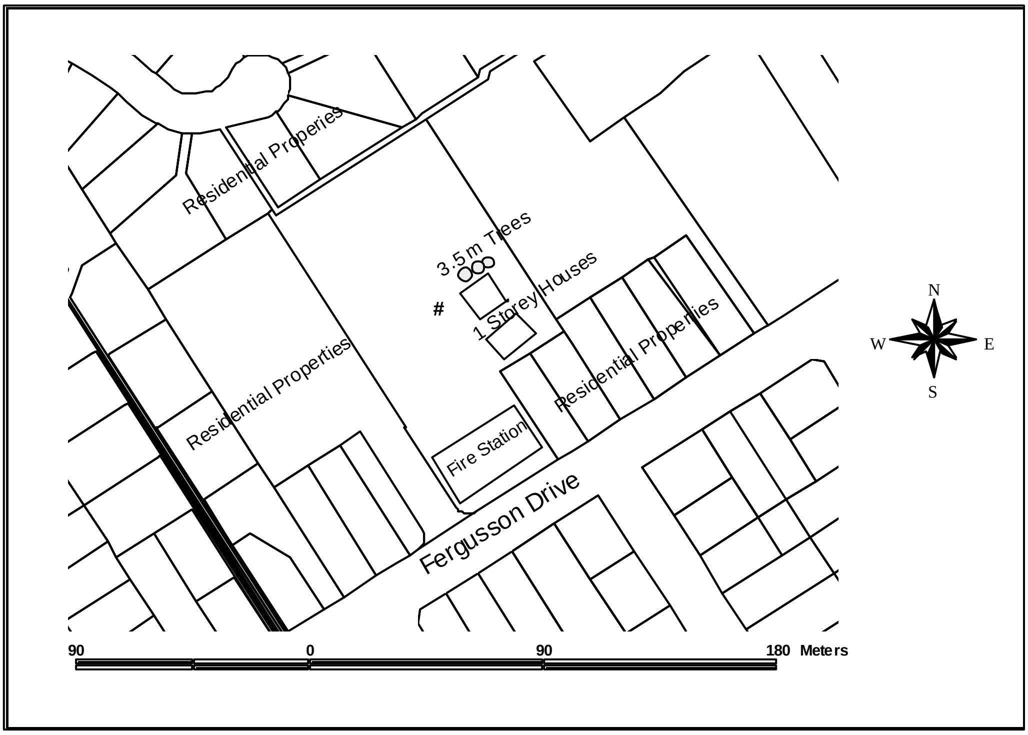


Figure 4.2: Monitoring site (●) layout at Trentham Fire Station, Upper Hutt

The northern side of the monitoring station was up against a 2m fence and beyond that, approximately 20 m away, were two one-storey residential houses. 70m to the east was the one-storey high Trentham Fire Station. To the west were open fields and beyond that were residential properties. To the south of the monitoring station (30 metres) was a practice tower for fire drills and then beyond that were residential properties.

The land around the site at Trentham Fire Station was flat and surrounded by open space or residential buildings no more than 2 storeys high. The nearest large structure to the monitoring station was the practice tower, which was also two storeys high.

The Trentham Fire Station site is approximately 3 kilometres southwest from the central business district of Upper Hutt City. Upper Hutt City is located in the Hutt Valley 30km northeast of Central Wellington and has a population of about 37,000. Land use in the area is predominantly residential with some light industrial activities.

The main urban area lies in a valley basin surrounded by hills up to 500 metres high. The Hutt River flows in through the top end of Upper Hutt and out through Taita Gorge which forms a natural topographical constriction at the southern end of the Upper Hutt basin. At times the atmospheric dispersion of pollutants discharged from various activities in Upper Hutt is severely limited and can lead to a build up of pollutants. Figure 4.3 is an aerial view of Upper Hutt City with the hills and farmland on either side of the river valley.

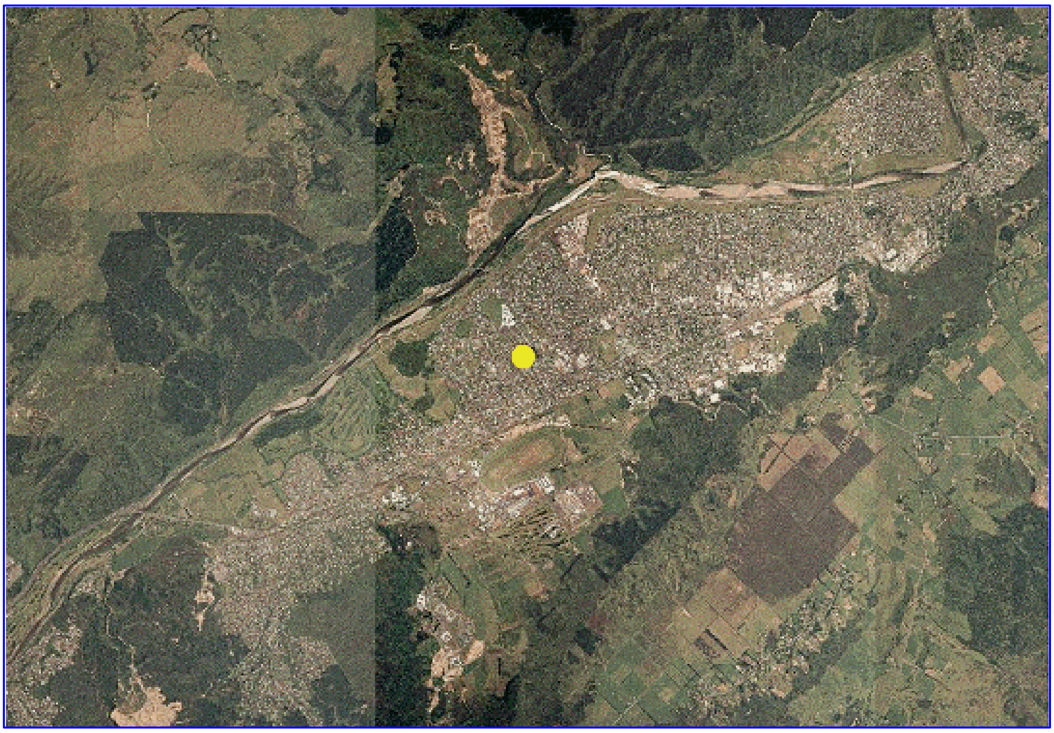


Figure 4.3: Aerial view of Upper Hutt urban area and monitoring site ( )

The predominant wind directions are from the northerly and southerly quarters as shown by the wind rose in Appendix 1.

Table 4.1 contains summary statistics of guideline pollutants for the monitoring period. The Maximum Desirable Level (MDL) or the National Ambient Air Quality Guideline (NAAQG) where an MDL has not been set is also indicated.

Table 4.1: Summary statistics for Trentham Fire Station, Upper Hutt

Parameter	NO_2 (mg/m^3)		PM_{10} (mg/m^3)	CO (mg/m^3)	
Averaging Time	**1 Hour** (NAAQG=200)	**24 Hour** (NAAQG=100)	**24 Hour** (NAAQG=50)	**1 Hour** (NAAQG=30)	**8 Hour** (NAAQG=10)
Maximum	65	29	39	5.7	2.7
99.9 Percentile	52	29	36	4.5	2.5
99.5 Percentile	47	26	33	3.1	2.2
75 Percentile	15	14	17	0.3	0.3
Mean	10	10	15	0.3	0.3
Median	6	10	14	0.1	0.1
25 Percentile	2	4	11	0.03	0.1

4.1.2 Nitrogen dioxide (NO_2)

1-hour moving average

Figure 4.4 is a graph of the 1-hour moving average of NO_2 concentrations at Trentham Fire Station for the monitoring period. The 1-hour NAAQG(MDL) of 95 µg/m^3 for NO_2 is also shown. The National Ambient Air Quality Guideline (NAAQG) of 200 µg/m^3 for NO_2 is not shown for scaling clarity.

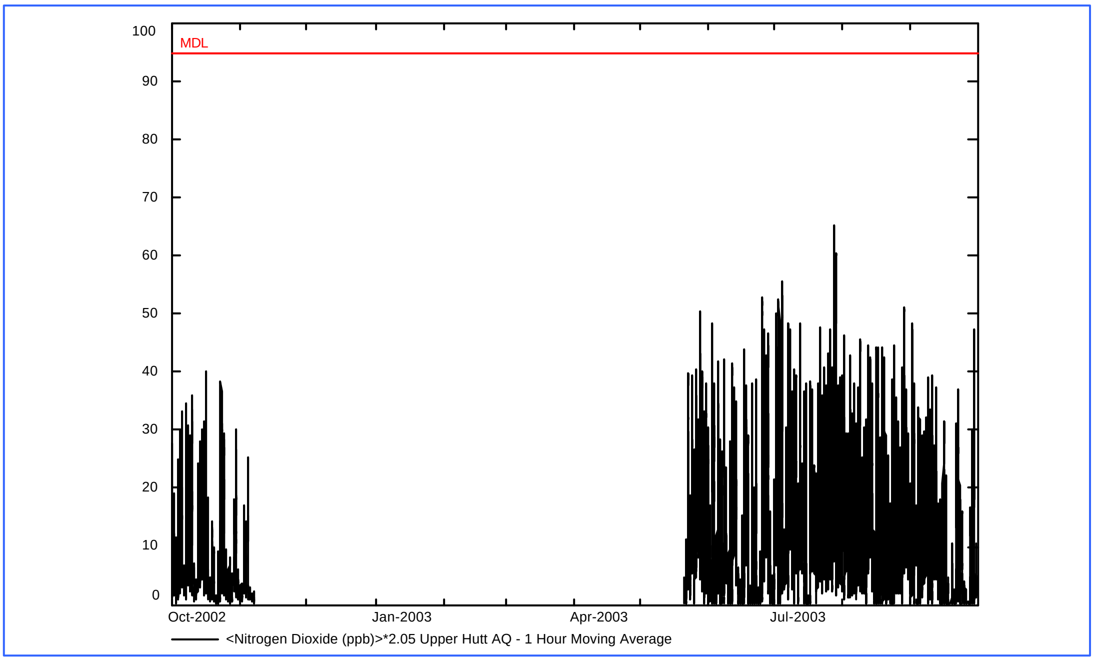


Figure 4.4: 1-hour moving average NO_2 (µg/m^3) at Trentham Fire Station from 1/10/02 to 1/10/03

The gap in the data was due to instrument failure, and therefore the statistics generated should be treated with caution.

24-hour moving average

Figure 4.5 is a graph of the 24-hour moving average of NO_2 concentrations at Trentham Fire Station for the monitoring period. The graph also indicates the MDL of 30 µg/m^3 and NAAQG of 100 µg/m^3.

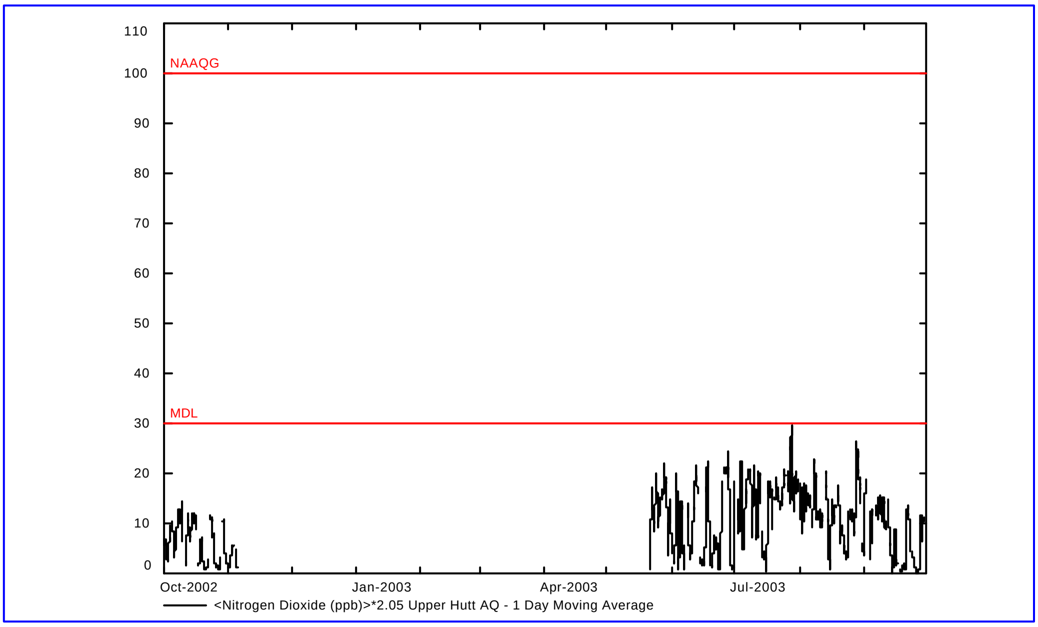


Figure 4.5: 24-hour moving average NO_2 ($\mu g/m^3$) at Trentham Fire Station from 1/10/02 to 1/10/03

Analysis of NO_2 monitoring results

There were no exceedences of the NO_2 1-hour MDL of 95 $\mu g/m^3$ or the 24-hour MDL of 30 $\mu g/m^3$ during the monitoring period. Winter time is when the highest levels of NO_2 were recorded, although there is a large slice of data lost from the summer period due to instrument failure.

Data from the Wellington Regional Emissions Inventory indicates that motor vehicles are the major contributor to NO_2 emissions on a typical winter's day. Figure 4.7 provides a comparison of the NO_2 monitoring results with the relative ambient air quality guidelines using the categories described in Table 2.2.

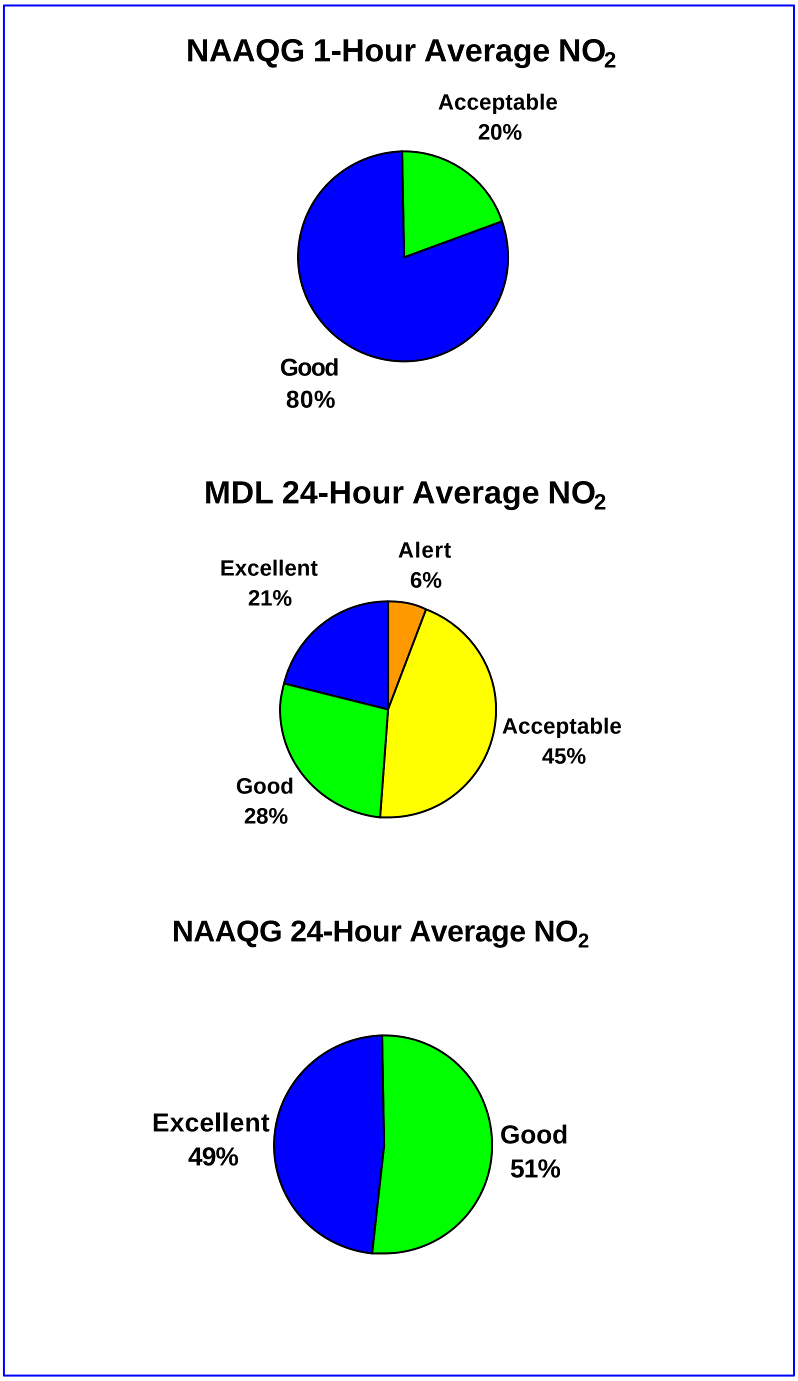


Figure 4.7: NO_2 monitoring results compared to air quality categories for the period October 2002 to October 2003

Figure 4.7 indicates that the NO_2 monitoring results at Trentham Fire Station compare favourably with the National Ambient Air Quality Guidelines.

4.1.3 Particulate matter (PM_{10})

1-hour moving average

Figure 4.8 is a graph of the 1-hour moving average of PM_{10} concentrations at Trentham Fire Station for the monitoring period. There is no guideline value for 1-hour concentrations.

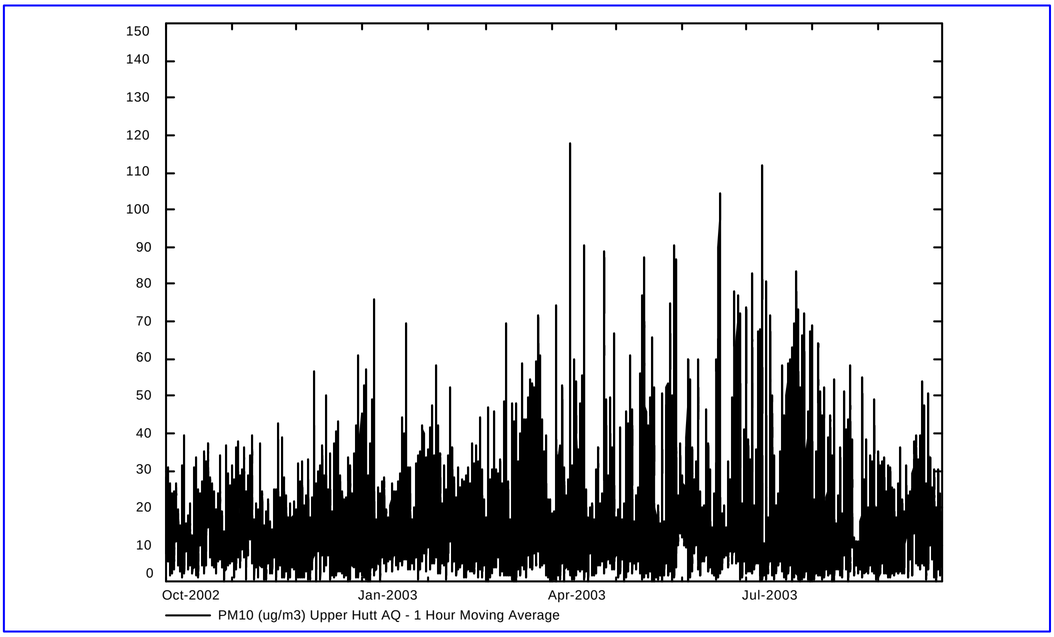


Figure 4.8: 1-hour moving average PM_{10} (mg/m³) at Trentham Fire Station from 01/10/02 to 1/10/03

24-hour moving average

Figure 4.9 is a graph of the 24-hour moving average of PM_{10} concentrations at Trentham Fire Station for the monitoring period. The graph also indicates the 24-hour NAAQG of 50 $\mu g/m^3$.

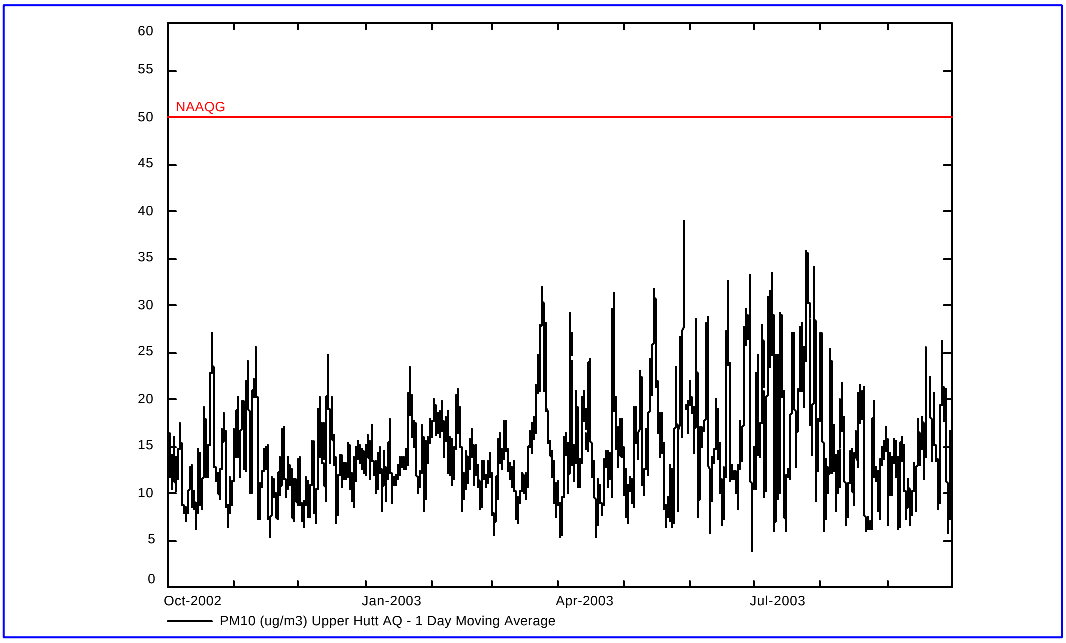


Figure 4.9: 24-hour moving average PM_{10} (mg/m³) at Trentham Fire Station from 01/10/02 to 1/10/03

Analysis of PM_{10} monitoring results

The highest 24-hour moving average concentrations for PM_{10} at Upper Hutt were recorded in July 2003. The peak PM_{10} levels during the winter of 2003 were lower than those recorded for the previous winter. This is most likely due to milder weather this winter.

The peaks in PM_{10} are likely to be caused by smoke emissions from domestic solid fuel heating appliances.

Figure 4.10 shows the monitoring results compared with the relevant ambient air quality guidelines using the air quality categories described in Table 2.2. The National Ambient Air Quality Guideline for PM_{10} (50 $\mu g/m^3$) was not exceeded during the past year.

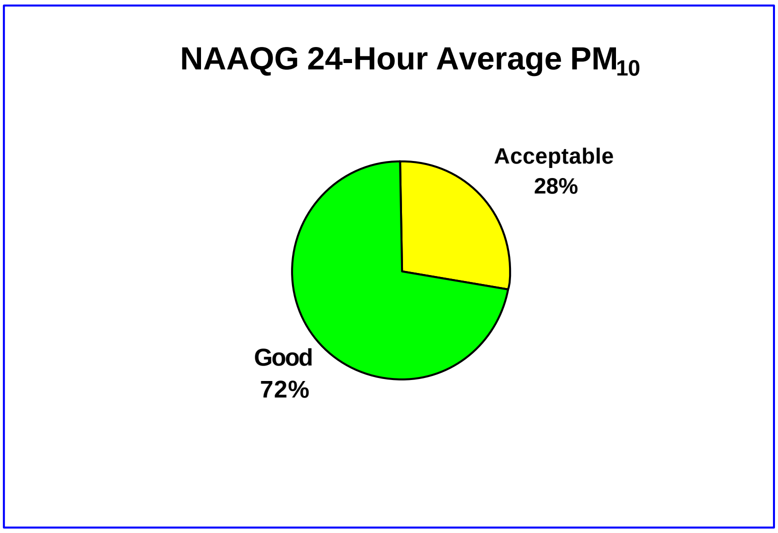


Figure 4.10: PM_{10} monitoring results at Upper Hutt compared to air quality categories for the period October 2002 to October 2003

The trend in ambient PM_{10} concentrations throughout the monitoring period was similar to that of NO_2 with higher concentrations recorded during the winter.

4.1.4 Carbon monoxide (CO)

1-hour moving average

Figure 4.11 is a graph of the 1-hour moving average of CO concentrations at Trentham Fire Station for the monitoring period. The 1-hour NAAQG of 30 mg/m^3 for CO is not shown for scaling clarity.

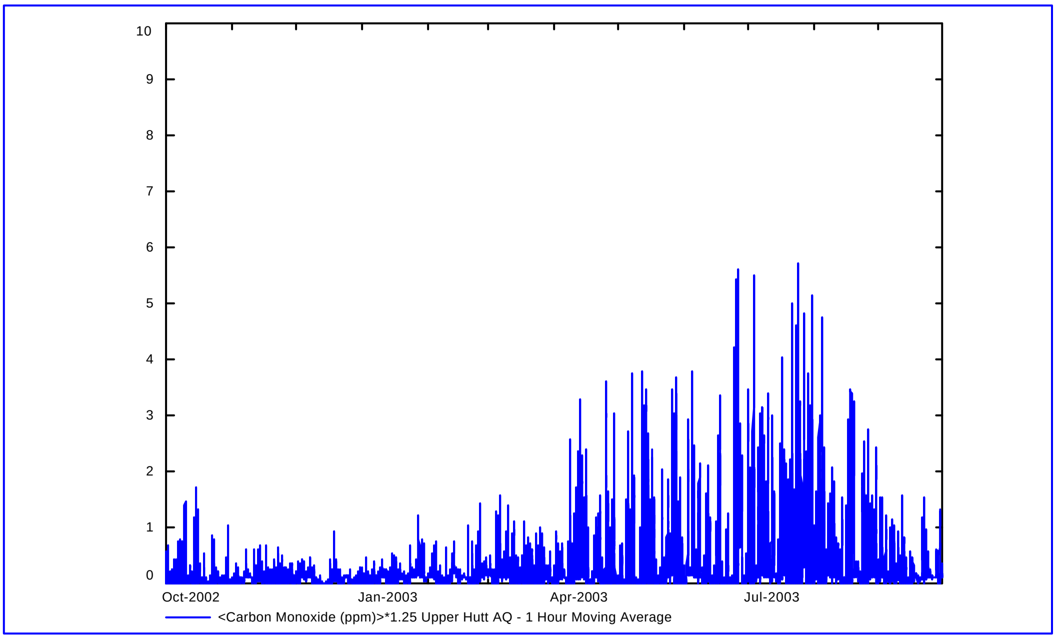


Figure 4.11: 1-hour moving average CO (mg/m³) at Trentham Fire Station from 1/10/02 to 1/10/03

8-Hour moving average

Figure 4.12 is a graph of the 8-hour moving average of CO concentrations at Trentham Fire Station for the monitoring period. The graph also indicates the 8-hour NAAQG of 10 mg/m^3 and the MDL of 6 mg/m^3.

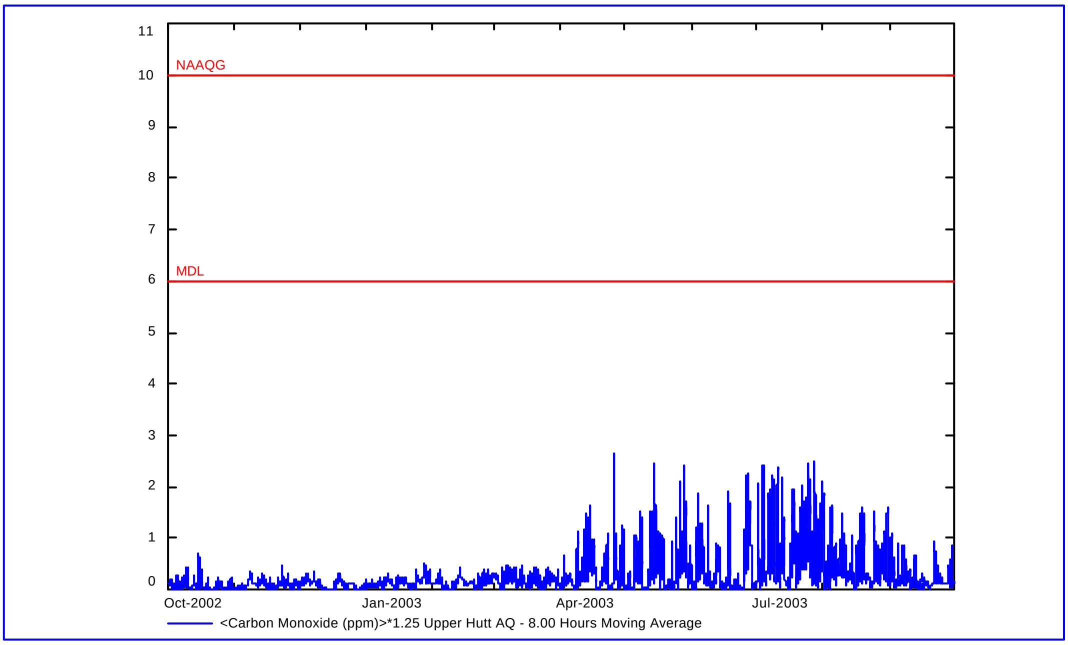


Figure 4.12: 8-hour moving average CO (mg/m³) at Trentham Fire Station from 1/10/02 to 1/10/03

Analysis of CO monitoring results

There were no exceedences of either the MAL or the MDL during the monitoring period. The peaks in CO are likely to be due to a combination of motor vehicle exhaust emissions and emissions from domestic solid fuel heating appliances.

Figure 4.13 illustrates the comparison of the monitoring results with the relative ambient air quality guidelines using the air quality categories described in Table 2.2.

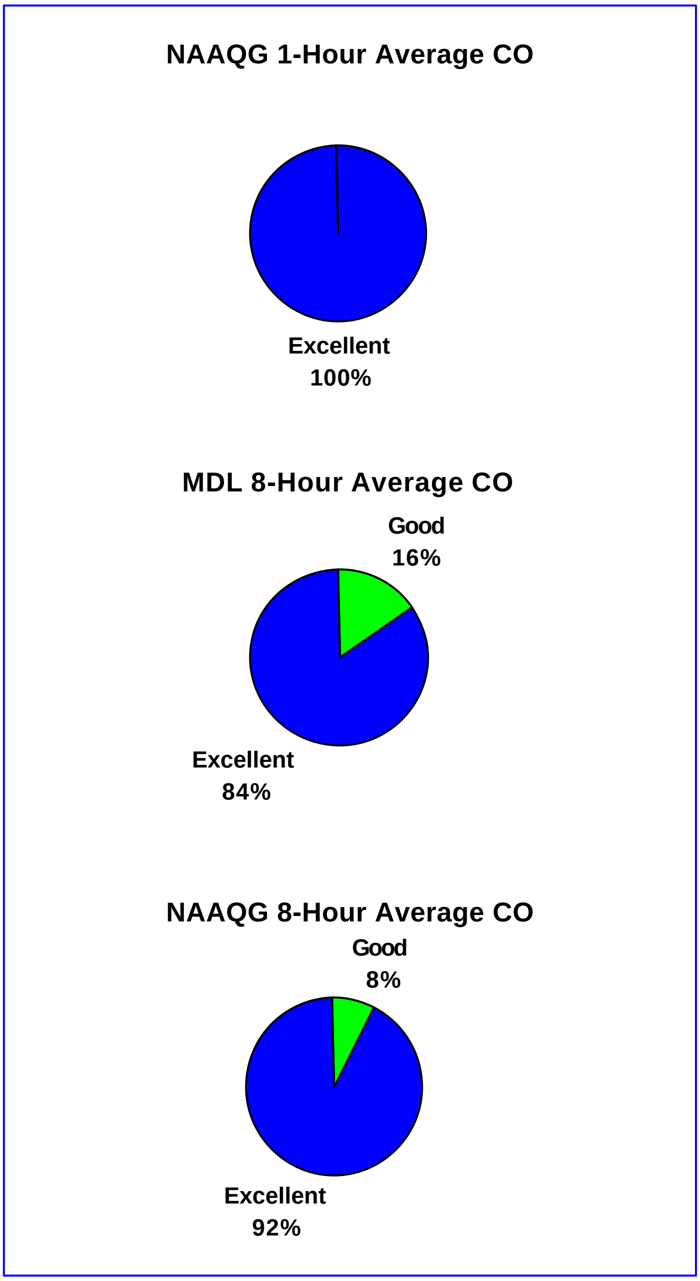


Figure 4.13: CO monitoring results compared to air quality categories for the period October 2002 to October 2003

Overall, the levels of CO recorded during the monitoring period were not at concentrations that could be considered a concern to human health based on the current guidelines. However, it is desirable that average pollutant concentrations do not increase beyond the current levels over the long term because the land use around the monitoring site is mainly recreational and residential.

CO concentrations showed a variation similar to NO_2 and PM_{10} with higher levels being recorded during the winter months.

4.2 Birch Lane, Lower Hutt

4.2.1 Site description

The Birch Lane Air Quality Monitoring Station is located within the grounds of Phil Evans Reserve, off Birch Lane in Lower Hutt (Grid Reference E2671059; N5997570, elevation 15m). Figure 4.14 shows a map of the area and Figure 4.15 details the site layout. The Birch Lane site is the first permanent air quality monitoring station for the Wellington Region.

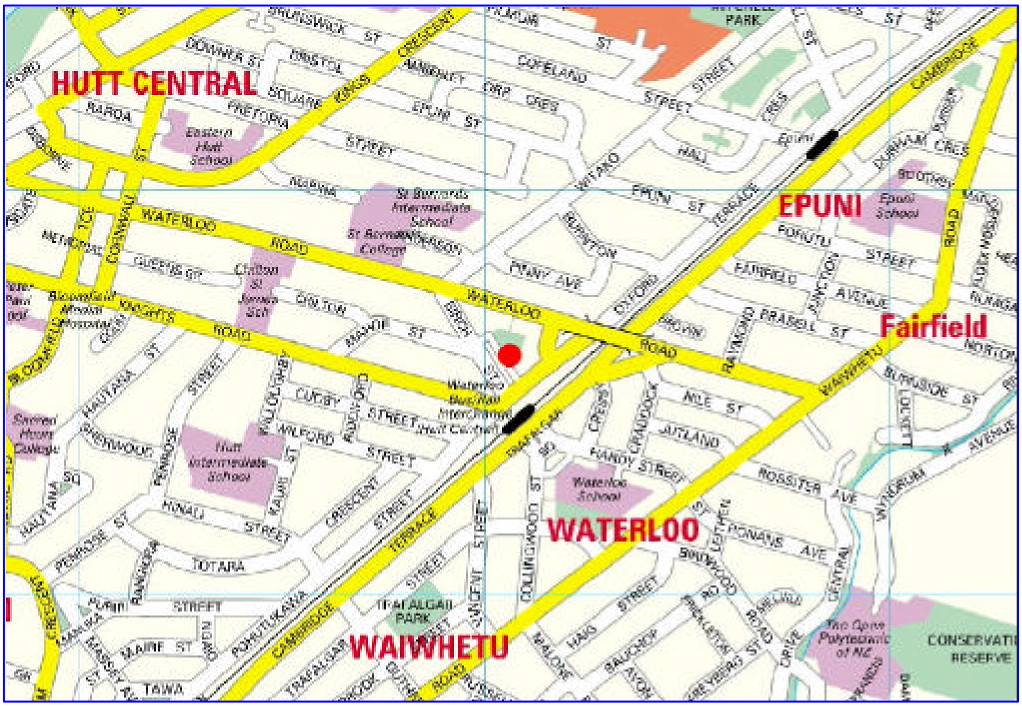


Figure 4.14: Map showing location of monitoring site (●)

The western side of the monitoring station is up against a one-storey building that serves as clubrooms for the local Scout Group. To the east, approximately 60m away, are a number of one-storey residential houses. 30m to the south are some one- and two-storey commercial buildings. To the north is an open grassed area that forms part of Phil Evans Reserve and beyond that are residential properties.

The land around the site at Birch Lane is flat and surrounded by open space or residential buildings. The nearest large structures to the monitoring station are some commercial buildings 50m to the south, these are up to two storeys high.

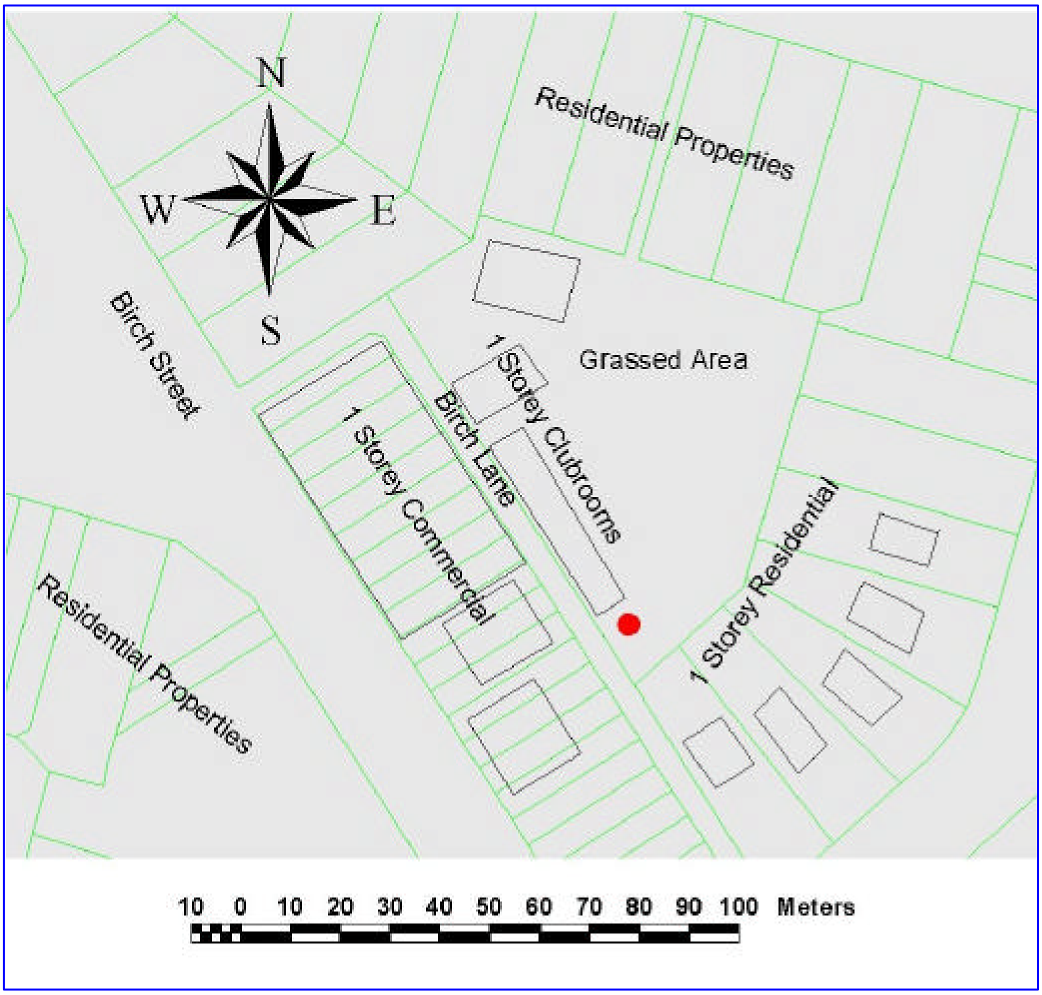


Figure 4.15: Monitoring site (●) layout at Birch Lane, Lower Hutt

The Birch Lane site is approximately 1 kilometre east of the central business district of Lower Hutt City. Lower Hutt City has a population of about 100,000 and is located in lower reaches of the Hutt Valley 15km northeast of central Wellington. Land use in the area is predominantly residential with some light industrial activities. Three kilometres to the south of the central business district is the industrial area of Seaview where a number of light to medium scale industrial activities operate.

The main urban area of Hutt City lies in a valley basin with hills up to 500 metres high on either side. The Hutt River runs through the middle of Lower Hutt and discharges into Wellington Harbour. The Hutt Valley is about 5km wide where it meets Wellington Harbour. At times the atmospheric dispersion of air contaminants discharged from various activities in Lower Hutt is limited and can lead to a build up of air pollution.

Figure 4.16 shows an aerial view of the Lower Hutt Valley and the Hutt city urban area.

Figure 4.16: Aerial photograph of Hutt City urban area and monitoring site (●)

The predominant wind directions at Lower Hutt are from the northerly and southerly quarters as shown by the wind rose in Appendix 2.

Table 4.2 contains summary statistics of guideline pollutants for the monitoring period. Also shown is the National Ambient Air Quality Guideline (NAAQG).

Table 4.2: Summary statistics for Birch Lane, Lower Hutt

Parameter	NO_2 (mg/m^3)		PM_{10} (mg/m^3)	CO (mg/m^3)	
Averaging Time	**1 Hour** (NAAQG=200)	**24 Hour** (NAAQG=100)	**24 Hour** (NAAQG=50)	**1 Hour** (NAAQG=30)	**8 Hour** (NAAQG=10)
Maximum	78	38	38	6.0	3.1
99.9 Percentile	65	36	35	4.2	2.5
99.5 Percentile	58	34	30	2.8	1.9
75 Percentile	17	18	11	0.7	0.7
Mean	13	13	14	0.5	0.5
Median	9	11	13	0.4	0.5
25 Percentile	5	7	11	0.3	0.3

4.2.2 Nitrogen dioxide (NO_2)

1-hour moving average

Figure 4.17 is a graph of the 1-hour moving average of NO_2 concentrations at Birch Lane for the monitoring period. Also shown is the 1-hour NAAQG(MDL) of 95 μg/m^3 for NO_2. The 1-hour NAAQG of 200 μg/m^3 for NO_2 is not shown for scaling clarity.

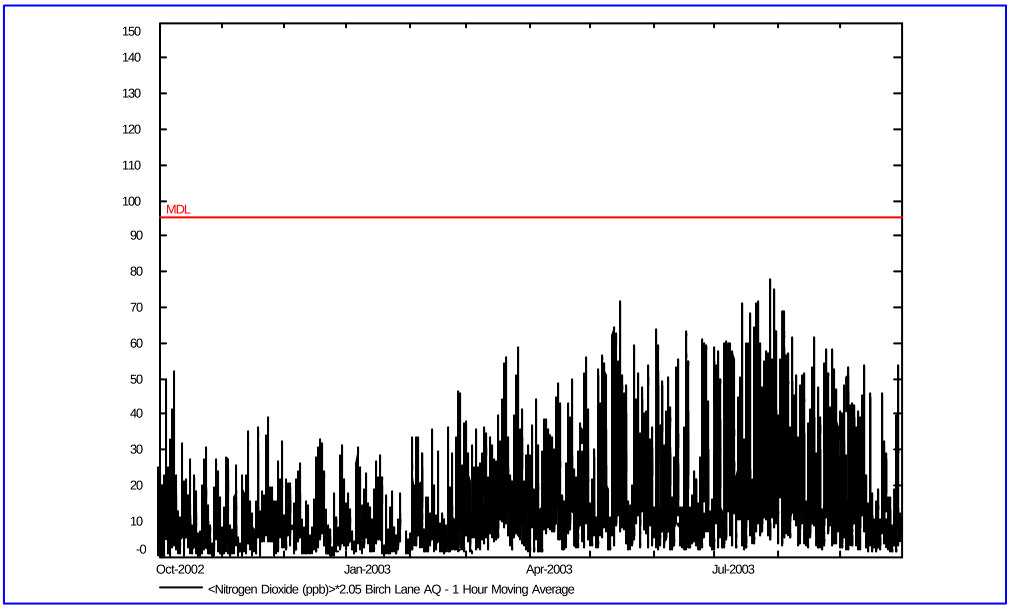


Figure 4.17: 1-hour moving average NO_2 (mg/m^3) at Birch Lane from 1/10/02 to 1/10/03

24-hour moving average

Figure 4.18 is a graph of the 24-hour moving average of NO_2 concentrations at Birch Lane for the monitoring period. The graph also indicates the 24-hour national ambient air quality guideline of 100 μg/m^3 and the maximum desirable level (MDL) of 30 μg/m^3.

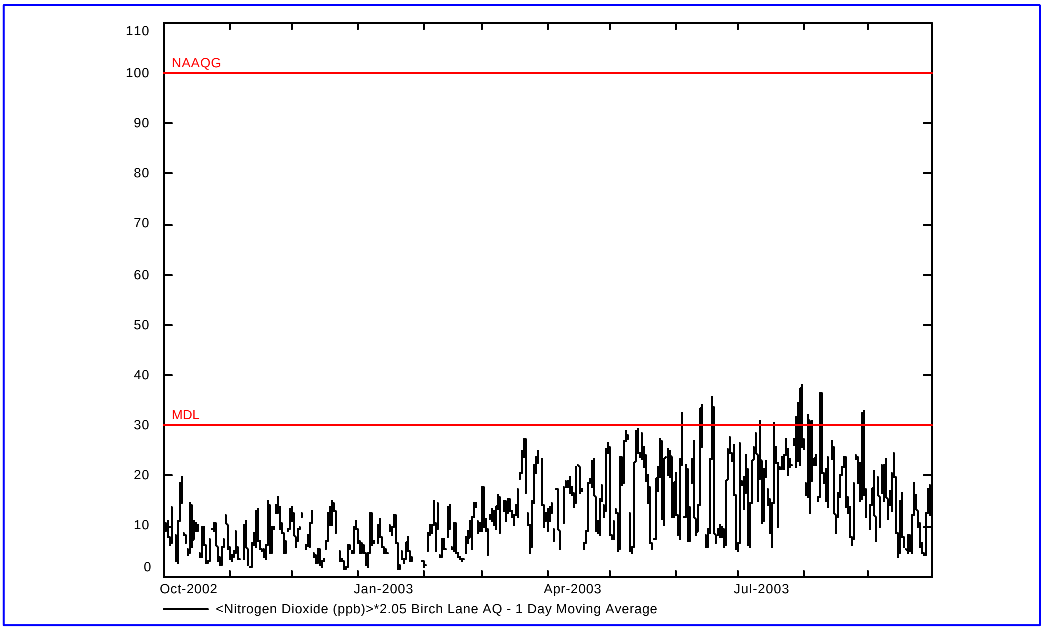


Figure 4.18: 24-hour moving average NO_2 (mg/m³) at Birch Lane from 1/10/02 to 1/10/03

Analysis of NO2 monitoring results

There were a number of exceedences of the NO_2 24-hour MDL of 30 $\mu g/m^3$ recorded during the monitoring period. All exceedences were recorded during the winter period

Closer analysis of the NO_2 data for Lower Hutt shows a diurnal pattern of peaks in NO_2 concentrations in the morning and again in the evening. This is likely to be as a result of motor vehicle emissions from heavier traffic in the morning and then again in the afternoon/evening associated with commuter 'rush hours'. There would also be some contribution to ambient NO_2 concentrations from domestic fires and residential and commercial gas heating during the winter. Calmer meteorological conditions also prevail in the mornings and evenings as compared to the middle of the day allowing the build-up of air pollutants.

Data from the Wellington Regional Emissions Inventory indicates that motor vehicles are the major contributor to NO_2 emissions on a typical winter's day.

Figure 4.19 provides a comparison of the monitoring results with the relative ambient air quality guidelines using the categories described in Table 2.2.

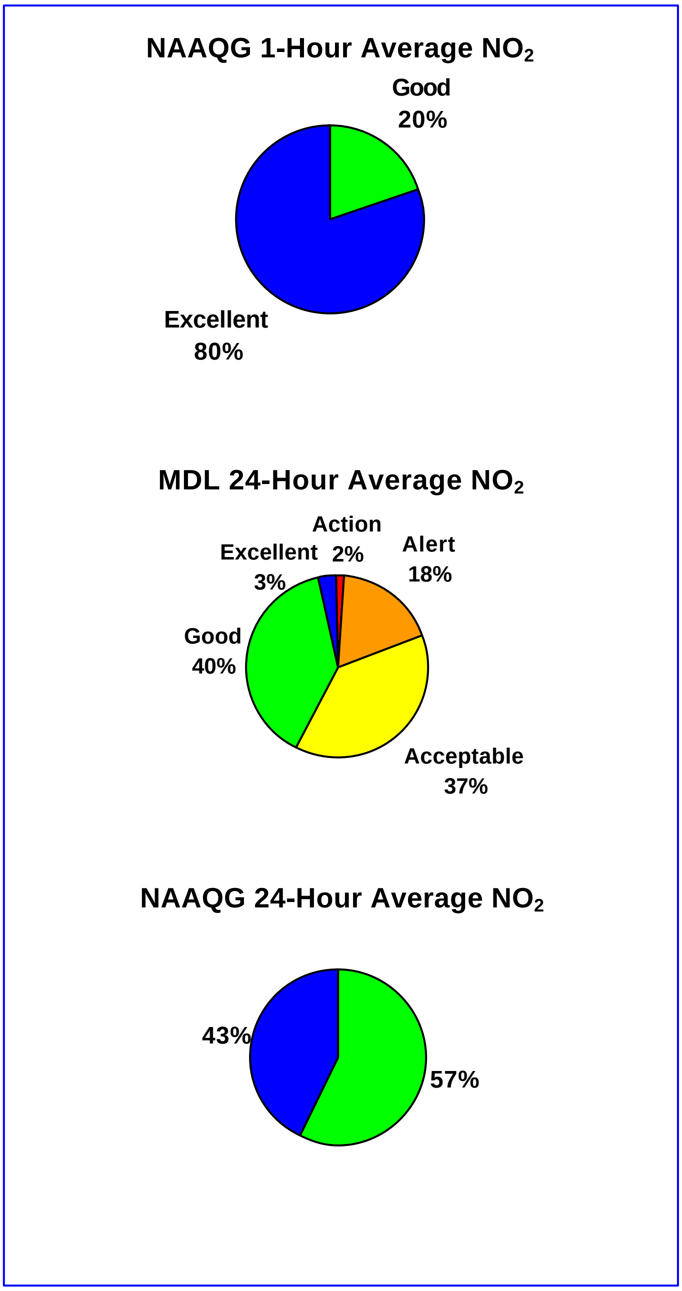


Figure 4.19: NO_2 monitoring results compared to air quality categories for the period October 2002 to October 2003

Figure 4.19 indicates that the NO_2 monitoring results at Birch Lane compare favourably with the National Ambient Air Quality Guidelines. NO_2 concentrations fell mainly into the acceptable to alert categories for the 24-hour MDL. While it would appear that NO_2 concentrations do not currently pose a problem to human health, the exceedences of the MDL suggests that there may be some adverse effects for the wider environment, especially for sensitive ecosystems. Whether any of these adverse effects are significant or not, has yet to be determined.

4.2.3 Particulate matter (PM_{10})

1 hour moving average

Figure 4.20 is a graph of the 1-hour moving average of PM_{10} concentrations at Birch Lane for the monitoring period. There is no guideline value for 1-hour concentrations.

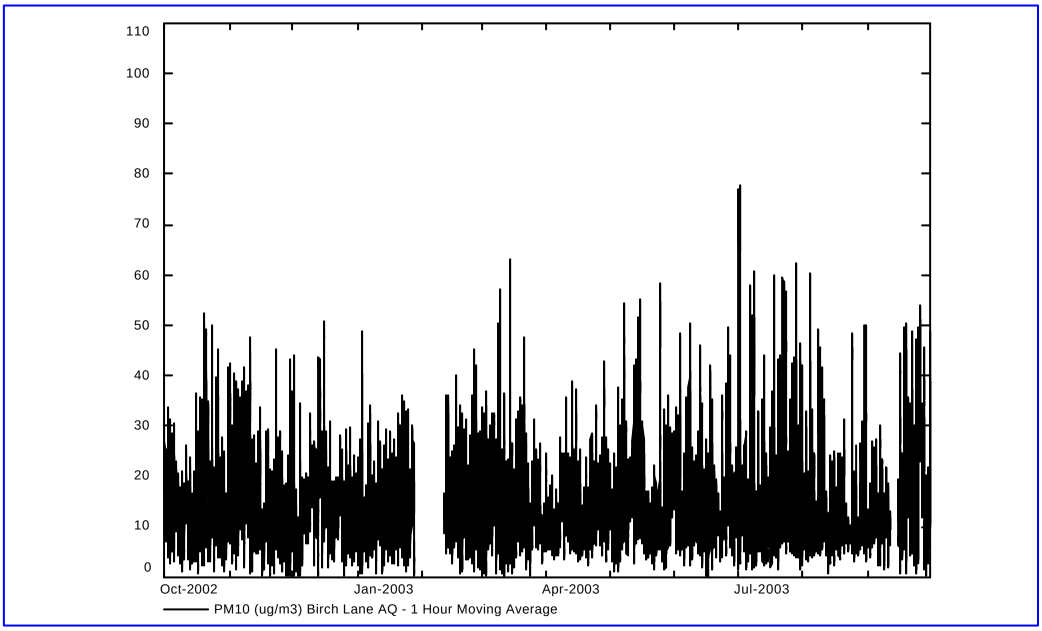


Figure 4.20: 1 hour moving average PM_{10} (mg/m^3) at Birch Lane from 1/10/02 to 1/10/03

24-hour moving average

Figure 4.21 is a graph of the 24-hour moving average of PM_{10} concentrations at Birch Lane for the monitoring period. The graph also indicates the 24-hour NAAQG of 50 µg/m^3.

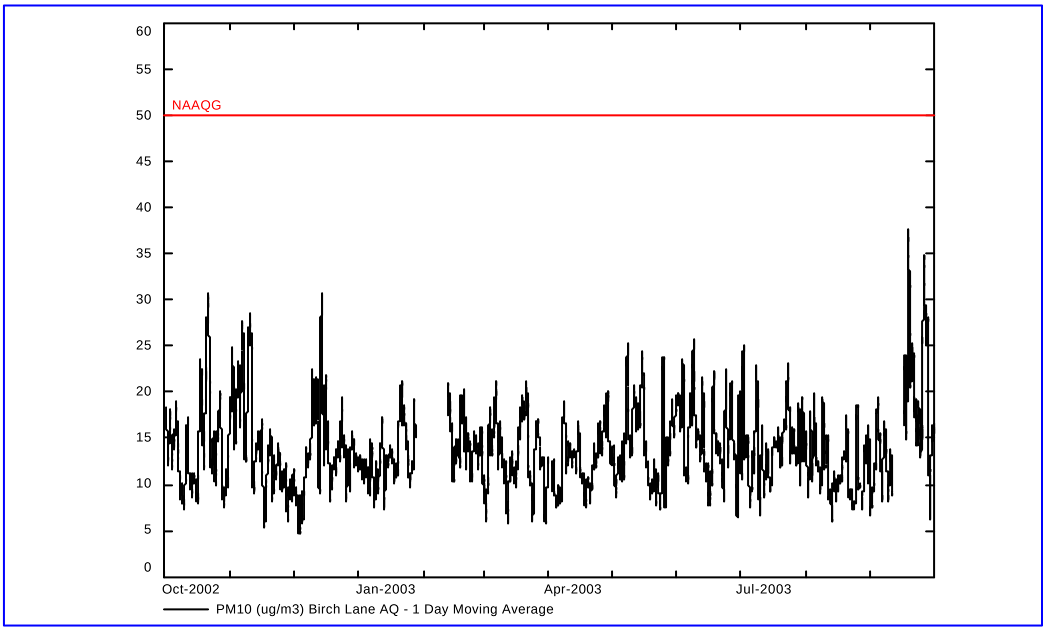


Figure 4.21: 24-hour moving average PM_{10} (μg/m³) at Birch Lane from 1/10/02 to 1/10/03

Analysis of the PM_{10} data would suggest that peak fine particulate matter concentrations at Lower Hutt are slightly elevated during the winter. Although no guideline exceedences were recorded.

Analysis of PM10 monitoring results

Figure 4.22 shows of the monitoring results compared with the relevant ambient air quality guideline using the air quality categories described in Table 2.2, and with the National Ambient Air Quality Guideline for PM_{10} (50 $\mu g/m^3$).

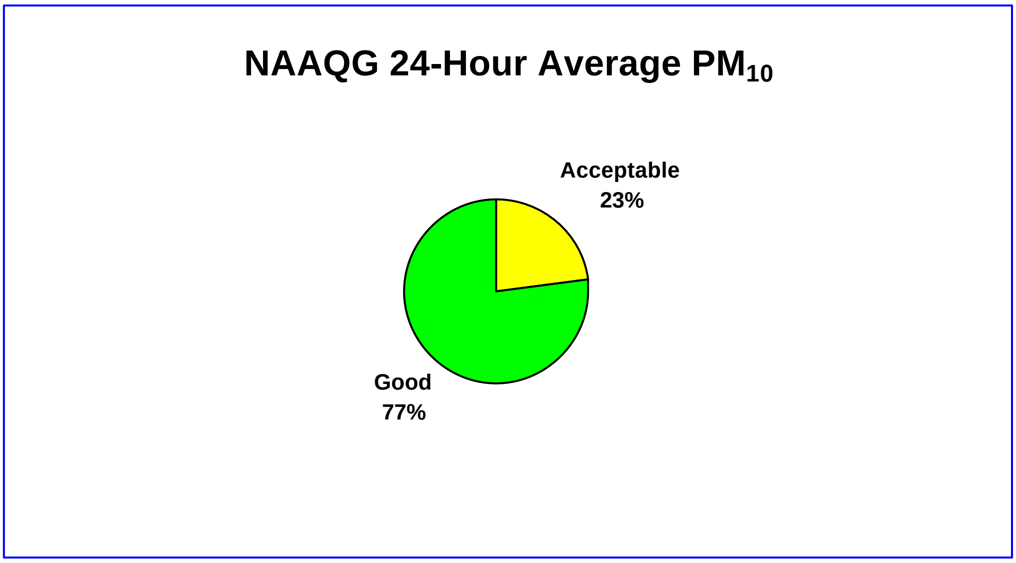


Figure 4.22: PM_{10} Monitoring Results at Lower Hutt Compared to Air Quality Categories for the Period October 2002 to October 2003

4.2.4 Carbon Monoxide (CO)

1-Hour Moving Average

Figure 4.23 is a graph of the 1-hour moving average of CO concentrations at Birch Lane for the monitoring period. The 1-hour NAAQG of 30 mg/m^3 for CO is not shown for scaling clarity.

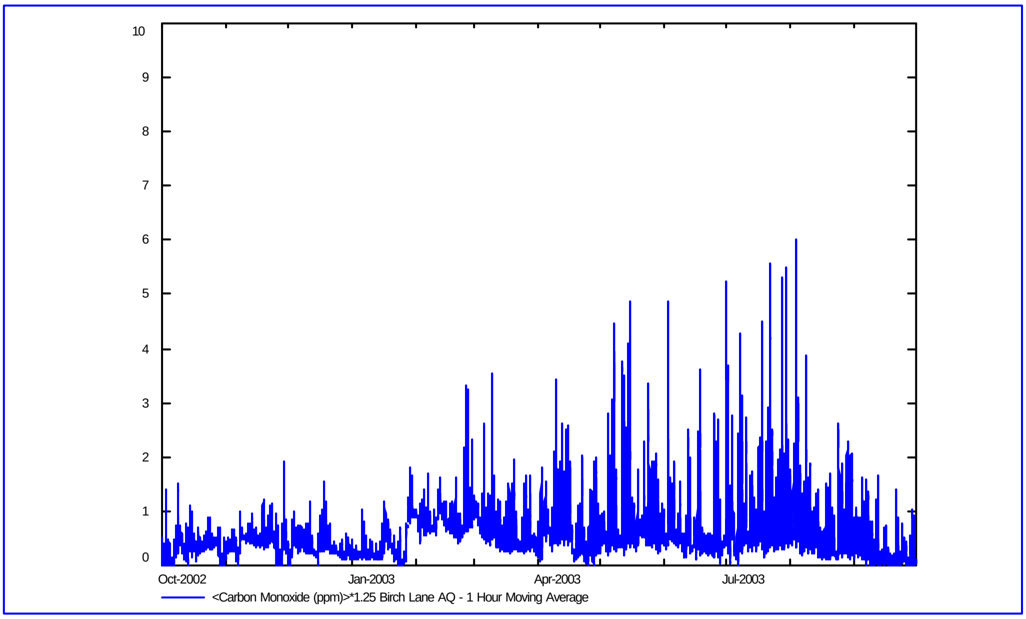


Figure 4.23: 1-hour moving average CO (mg/m^3) at Birch Lane from 1/10/02 to 1/10/03

8-hour moving average

Figure 4.24 is a graph of the 8-hour moving average of CO concentrations at Birch Lane for the monitoring period. The graph also indicates the 8-hour NAAQG of 10 mg/m^3 and the maximum desirable level (MDL) of 6 mg/m^3.

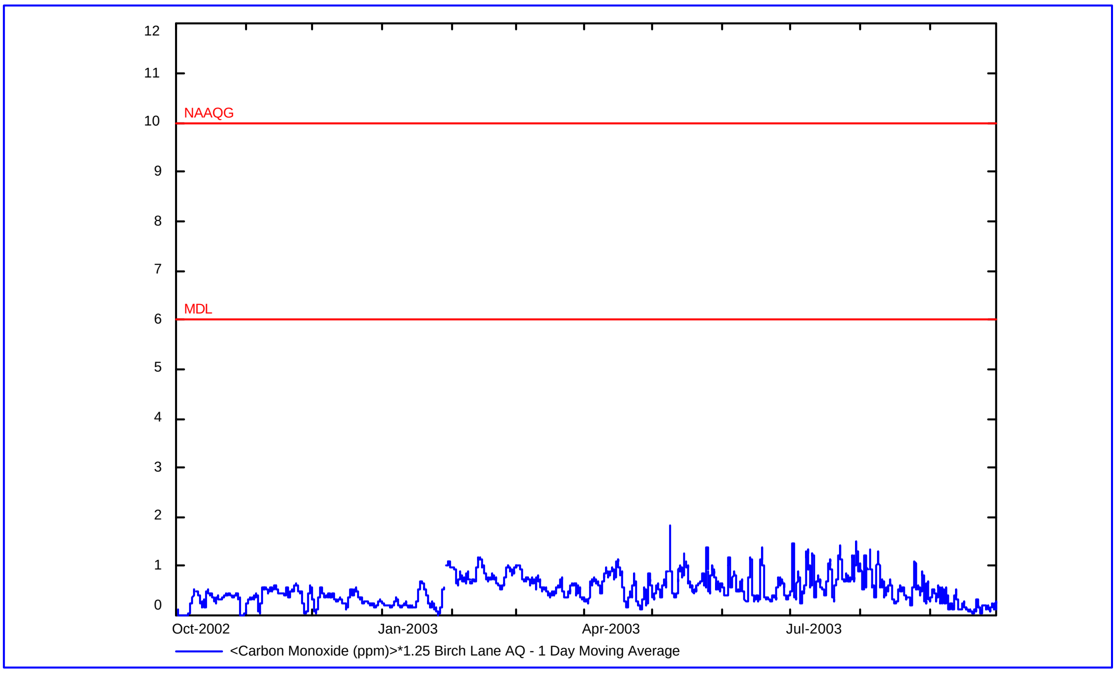


Figure 4.24: 8-hour moving average CO (mg/m³) at Birch Lane from 1/10/02 to 1/10/03

Analysis of CO monitoring results

There were no exceedences of either the MAL or the MDL during the monitoring period. Figure 4.25 illustrates the comparison of the monitoring results with the relative ambient air quality guidelines using the air quality categories described in Table 2.2.

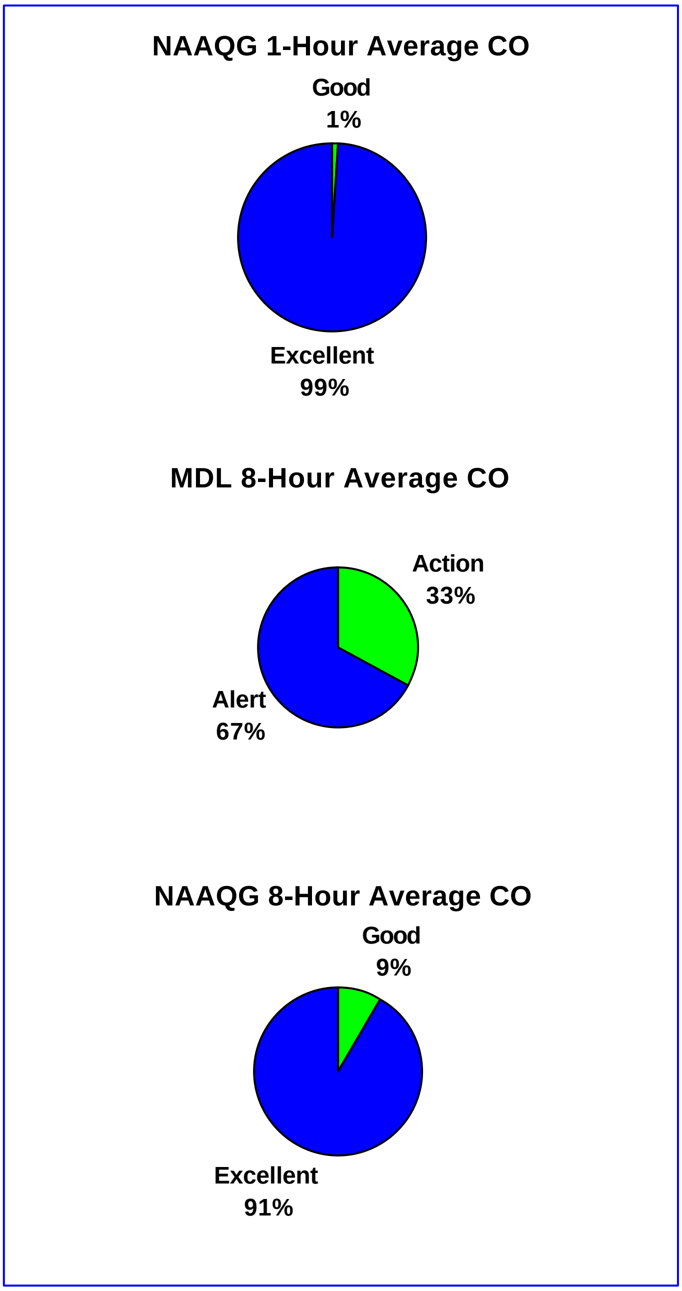


Figure 4.25: CO monitoring results compared to air quality categories for the period October 2002 to October 2003

Overall, the levels of CO recorded during the monitoring period were not at concentrations that could be considered a concern to human health based on the current guidelines. However, it is desirable that average pollutant concentrations do not increase beyond the current levels over the long term because the land use around the monitoring site is mainly recreational and residential.

CO concentrations showed a variation similar to NO_2 with higher levels being recorded during the winter months. The concentrations of both pollutants tended to peak at the same time, indicating that they are likely to be from the same sources.

4.3 Wainuiomata PM_{10} monitoring

4.3.1 Site description

A high volume sampler has been located at the Wainuiomata Bowling Club in Wainuiomata since 20 September 2000. (NZMS Grid Reference E2673668; N5991398, elevation 80m). The instrument is currently operating on a one-day-in-three sampling regime.

The sampler is located on a flat area of land at the Wainuiomata Bowling Club. Figures 4.26 and 4.27 show the site location and the site layout respectively.

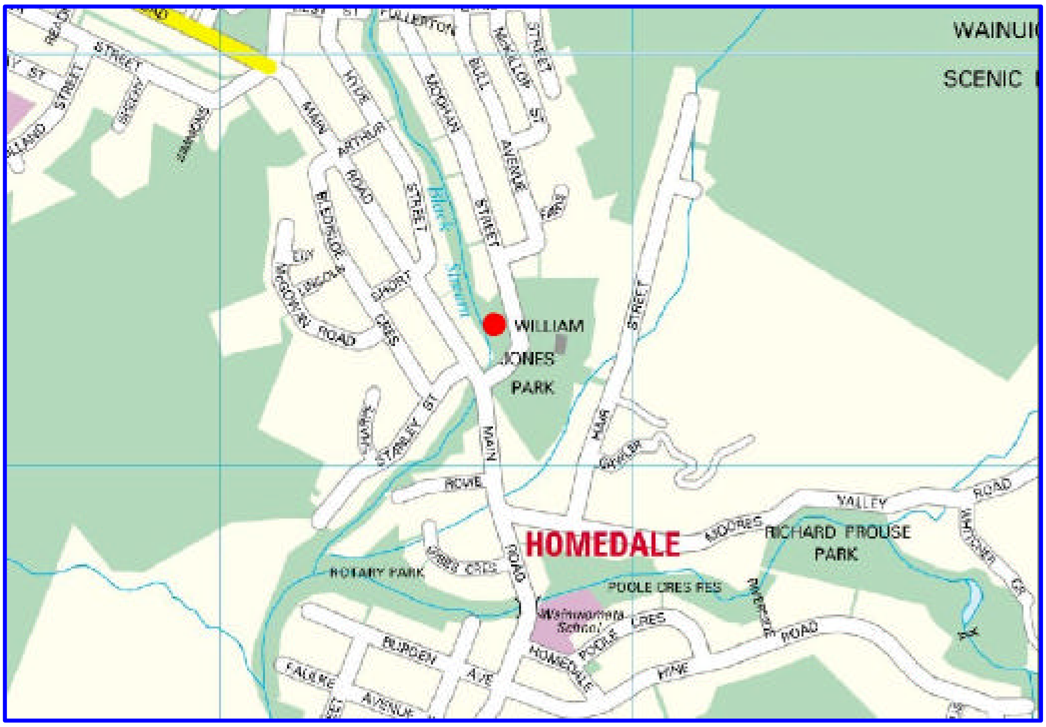


Figure 4.26: Location of Wainuiomata site (●)

The Wainuiomata Bowling Club site lies approximately 1km southeast of the main shopping centre. Wainuiomata has a population of about 16,500. The Wainuiomata valley is located east of the Hutt Valley and 20km northeast of central Wellington. The predominant land use around the site is residential with some adjacent recreational activities such as a swimming pool complex and rugby fields.

Wainuiomata lies in a basin shaped valley that has a narrow exit at the southern end through which the Wainuiomata River flows. The valley is surrounded by hills that are 300m high to the west, 600m high to the north and 800m high to the east. During the winter the valley is subject to frosts and meteorological inversion conditions. Many residential dwellings use solid fuel fires as a source of heating in the winter.

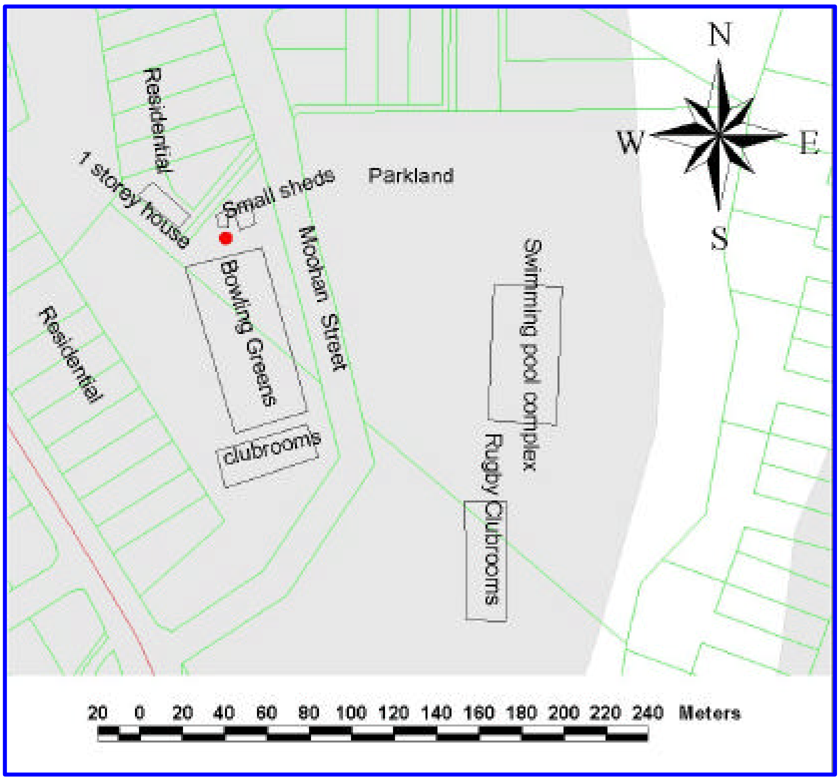


Figure 4.27: Site layout at Wainuiomata and hi-vol location (●)

Figure 4.28 is an aerial photograph of the Wainuiomata urban area and the monitoring site location.

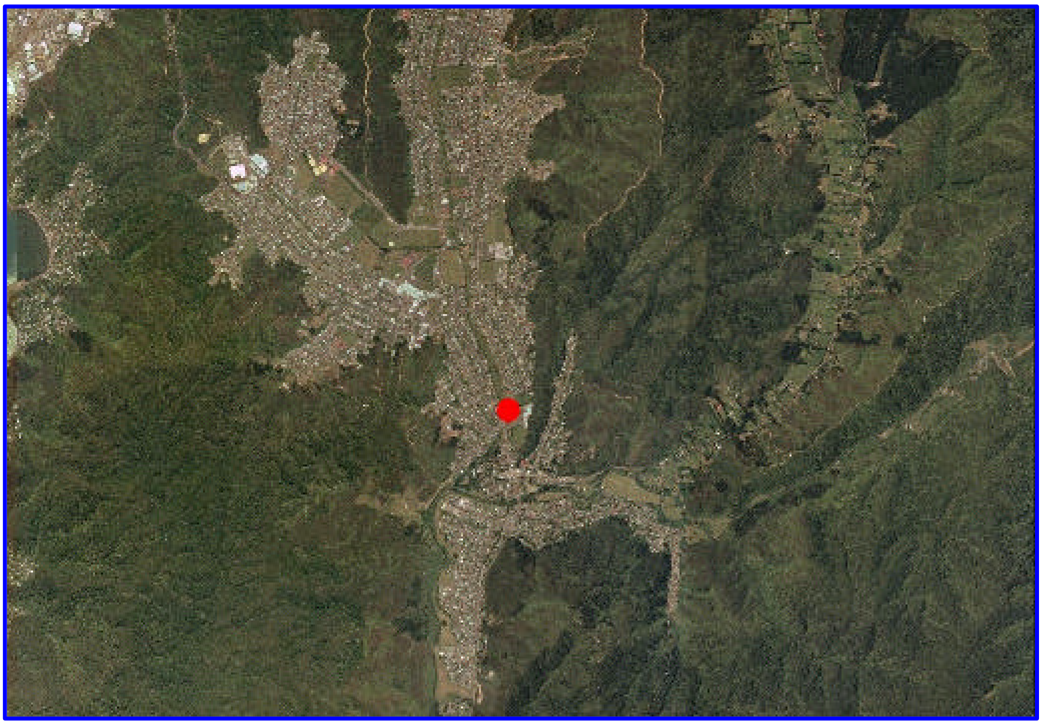


Figure 4.28: Aerial photo of Wainuiomata Urban area showing site location (●)

Technical parameters and meteorology

The high volume sampler is a gravimetric method for monitoring PM_{10}. Ambient air is passed through a size selective inlet and then through a pre-weighed filter that is removed after 24 hours of continuous sampling of ambient air at 70 m^3/hr and then reweighed. The results are expressed as the 24 hour average for that time period. The 24-hour monitoring period used for this study was 12:00 to 12:00 the following day. The high volume sampler is an Australian and USEPA Standard method.

The nearest meteorological station is at Shandon Golf Club, Lower Hutt which is approximately 5 km west of this site. Wainuiomata is predominately affected by northerly and southerly winds. Wind direction at the sampling site would have been be similar to that experienced at Shandon Golf Club, however, wind speed and temperature would vary somewhat as the Wainuiomata Valley is decoupled from the Hutt Valley by a range of hills 300m high. Greater Wellington plans to establish a meteorological monitoring site in Wainuiomata during 2004 to provide appropriate meteorological parameters for air pollution studies.

4.3.2 Monitoring results for PM$_{10}$ at Wainuiomata

Figure 4.29 shows the discrete results for each 24 hour period monitored by the high volume sampler.

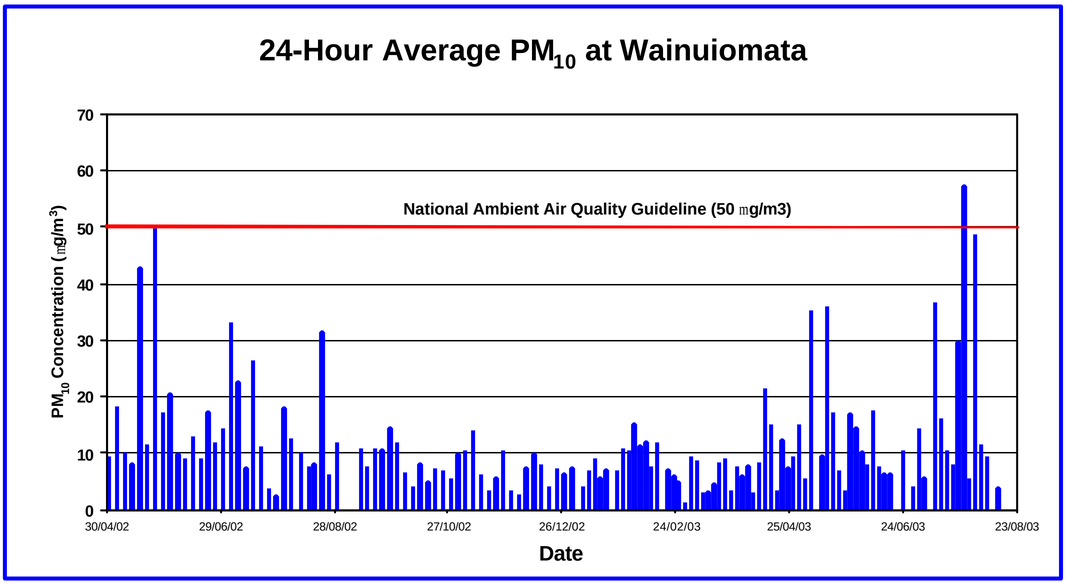


Figure 4.29: 24-hour average PM$_{10}$ at Wainuiomata Bowling Club 30/4/02 to 11/8/03

Table 4.3: Statistical summary of PM$_{10}$ monitoring data at Wainuiomata

Parameter	PM$_{10}$ (?g/m^3)
Averaging Time	**24 Hour (NAAQG=50)**
Maximum	57
99.9 Percentile	56
99.5 Percentile	53
95 Percentile	31
75 Percentile	12
Mean	11
Median	8
25 Percentile	6

The maximum 24-hour average PM$_{10}$ concentration measured was 57 µg/m^3 for the 24 hour period ending at 12:00 on 26 July 2003. This was the only exceedence of the NAAQG for PM$_{10}$ of 50µg/m^3 during the monitoring period. The exceedence occurred when there was a cold snap of weather in Wellington. A peak in 24-hour PM$_{10}$ (35 µg/m^3) also occurred at Upper Hutt on the same day. Concentrations of particulate matter during the summer were found to be generally low.

4.3.3 Analysis of PM$_{10}$ monitoring results

Greater Wellington used the Wainuiomata site as part of an air pollution screening programme for the Wellington Region. Wainuiomata had been suspected of having the meteorological conditions conducive to pollution events. The use of solid fuel fires for domestic heating is suspected as the main source of air pollution.

National Guideline of 50 $\mu g/m^3$ was exceeded on one occasion. It is possible that other days where PM_{10} was also high were missed as the monitoring programme uses a one-day-in-three sampling regime. A longer term monitoring programme has now been established in Wainuiomata to determine annual trends in particulate concentrations. A meteorological monitoring station is to be established alongside the high volume sampler to provide meteorological data for air pollution studies.

Figure 4.30 provides a comparison of the monitoring results with the relative ambient air quality guidelines using the assessment categories described in Table 2.2

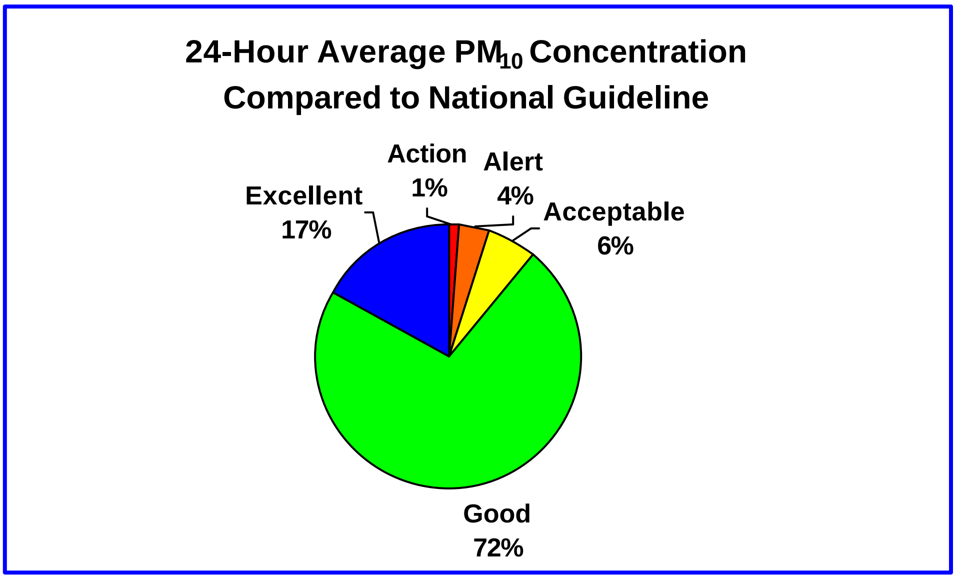


Figure 4.30: PM_{10} monitoring results compared to air quality categories for the period, October 2002 – September 2003

The higher results suggest there are air quality issues and potential for adverse human health effects in Wainuiomata during the winter. The likely sources of particulate pollution are domestic fires. Figure 4.31 is a photograph taken of smoke and haze lying in the Wainuiomata basin during the winter of 2002.

Figure 4.31: Smoke and haze over Wainuiomata during the winter of 2002

4.4 Wairarapa College, Masterton

4.4.1 Site description

The monitoring station was located within the grounds of Wairarapa College, off Cornwall Street in Masterton (Grid Reference E2732770; N6024885, elevation 100m) from October 2002 until October 2003. Co-located at the site were continuous CO, NOx and PM_{10} (TEOM) analysers and a PM10 high-volume sampler as a reference, various meteorological parameters were also monitored at the site. Figure 4.2 shows an aerial photo of Masterton.

Figure 4.32: Aerial photo of Masterton showing monitoring site (●)

Masterton is a rural town with a population of approximately 20,000. The town services the surrounding farming community. There are no major industries in Masterton itself and the predominant source of particulate matter emissions is from domestic solid fuel fires in the winter. Masterton is located on the flat river plain of the Wairarapa Valley which is approximately 20 kilometres wide. Figure 4.3 is a map of the local area surrounding the monitoring site.

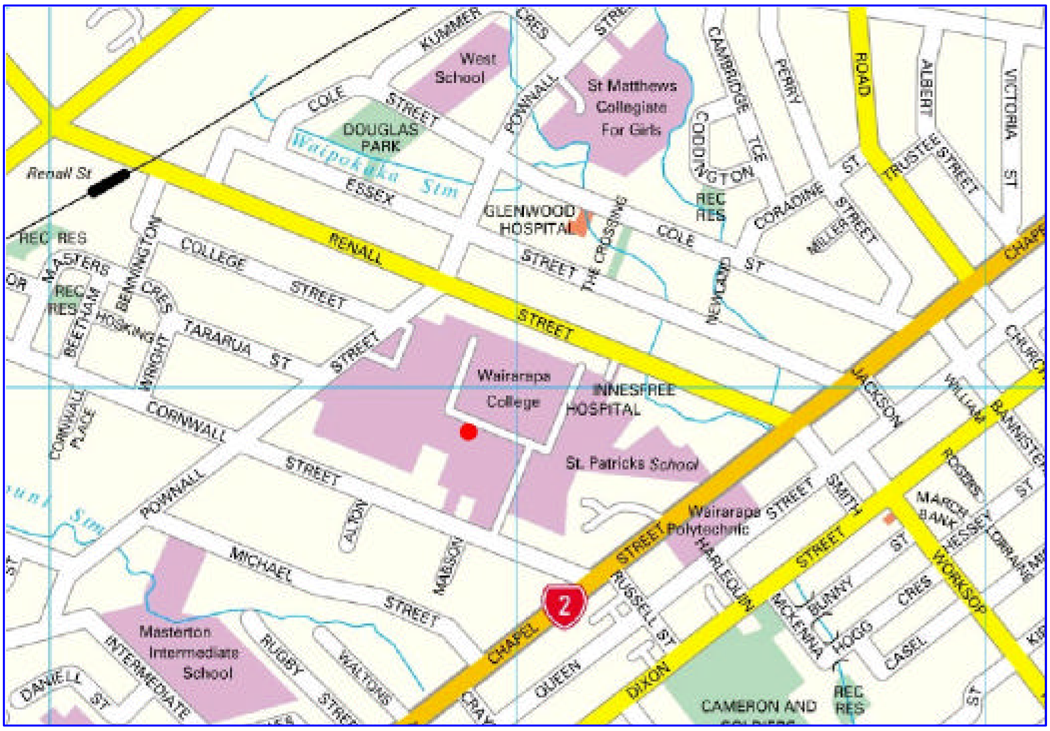


Figure 4.33: Local map of area around Wairarapa College monitoring site (●)

The Wairarapa College site was approximately one kilometre from the central business district of Masterton. The land around the school site was flat and surrounded by open space or school and residential buildings no more than two storeys high. Figure 4.34 shows the site layout.

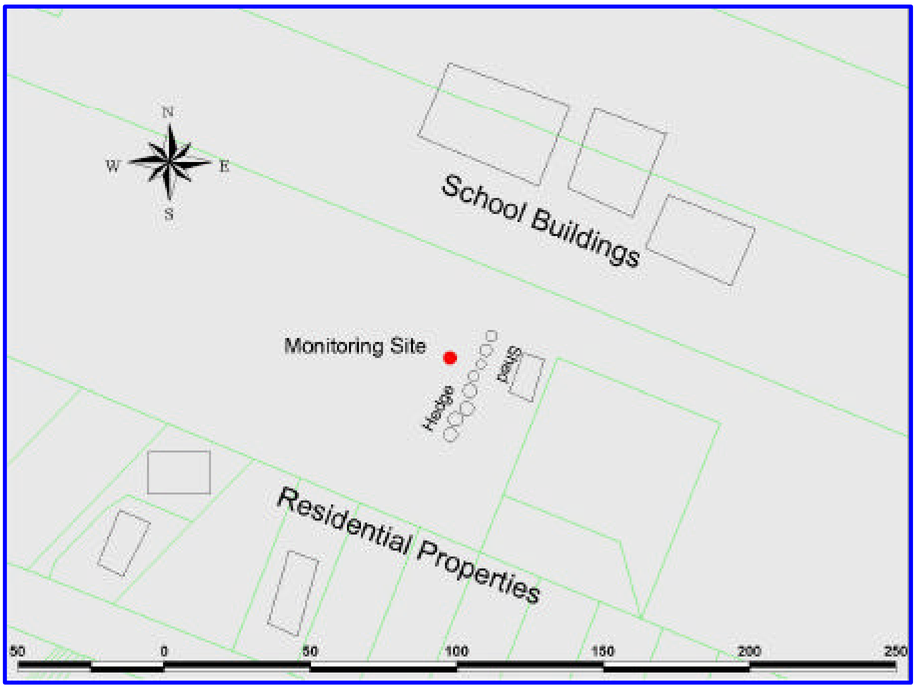


Figure 4.33: Site (●) layout around Wairarapa College monitoring station

The predominant wind directions at Wairarapa College are from the northerly and southwesterly quarters as shown by the wind rose in Appendix 3.

Table 4.2 contains summary statistics of guideline pollutants for the monitoring period. Also shown is the National Ambient Air Quality Guideline (NAAQG).

Table 4.2: Summary statistics for Wairarapa College, Masterton

Parameter	NO_2 (μg/m^3)		PM_{10} (μg/m^3)	CO (mg/m^3)	
Averaging Time	**1 Hour** (NAAQG=200)	**24 Hour** (NAAQG=100)	**24 Hour** (NAAQG=50)	**1 Hour** (NAAQG=30)	**8 Hour** (NAAQG=10)
Maximum	67	27	82	6.8	3.3
99.9 Percentile	53	26	79	4.1	2.9
99.5 Percentile	48	24	52	3.1	2.2
75 Percentile	12	13	18	0.1	0.1
Mean	10	10	16	0.2	0.2
Median	7	8	14	0.01	0.02
25 Percentile	4	6	11	0.01	0.01

4.4.2 Nitrogen dioxide (NO_2)

1-hour moving average

Figure 4.35 is a graph of the 1-hour moving average of NO_2 concentrations at Wairarapa College for the monitoring period. Also shown is the 1-hour maximum desirable level (MDL) of 95 μg/m^3 for NO_2. The 1-hour NAAQG of 200 μg/m^3 for NO_2 is not shown for scaling clarity.

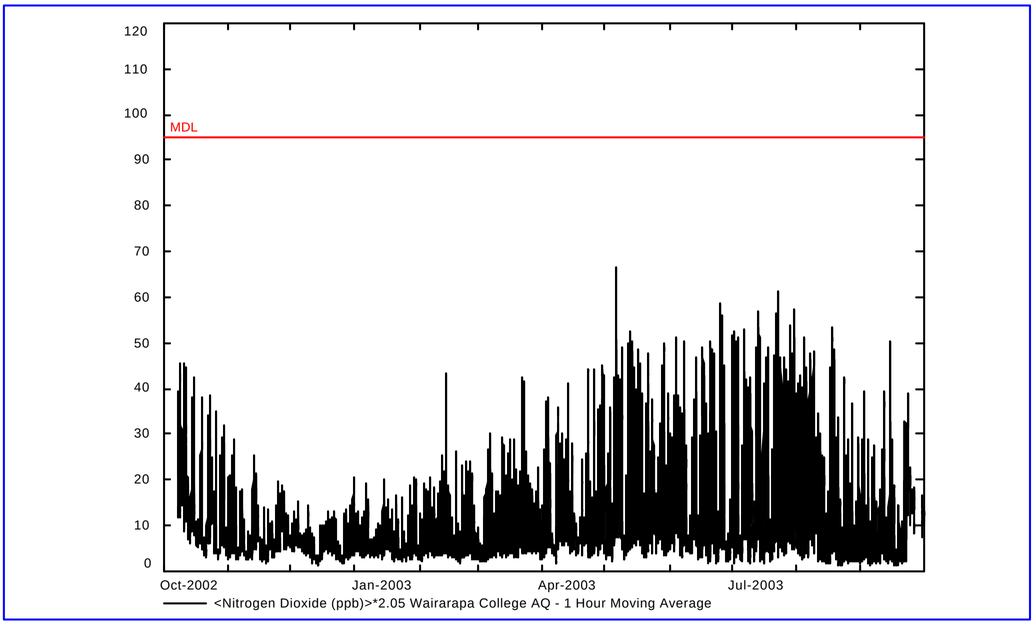


Figure 4.35: 1-hour moving average NO_2 (mg/m³) at Wairarapa College from 1/10/02 to 1/10/03

24-hour moving average

Figure 4.36 is a graph of the 24-hour moving average of NO_2 concentrations at Wairarapa College for the monitoring period. The graph also indicates the 24-hour national ambient air quality guideline of 100 $\mu g/m^3$ and the maximum desirable level (MDL) of 30 $\mu g/m^3$.

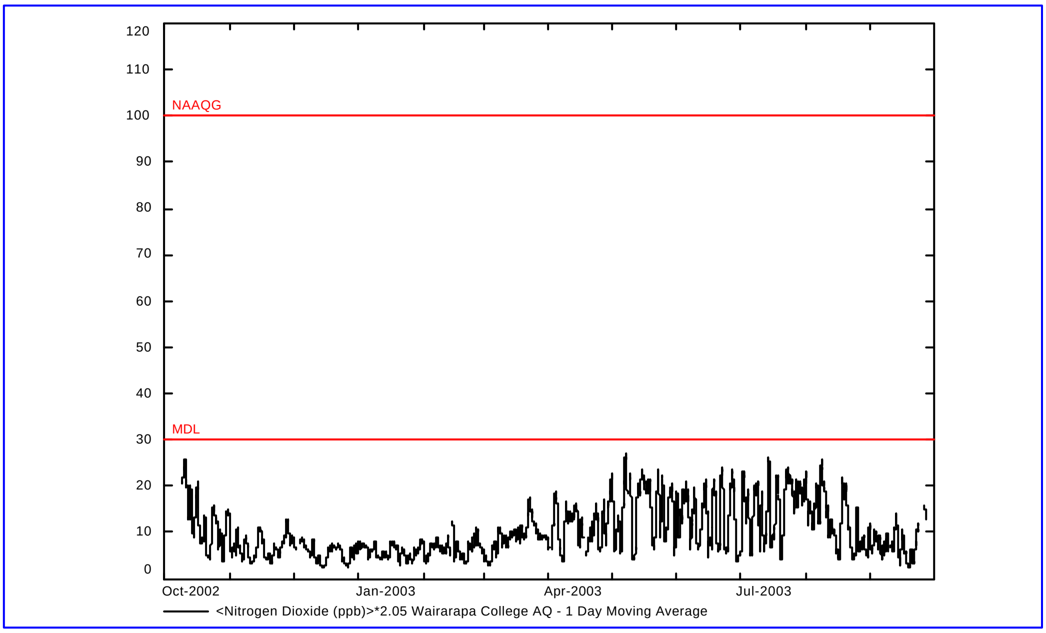


Figure 4.36: 24-hour moving average NO_2 (mg/m³) at Wairarapa College from 1/10/02 to 1/10/03

Analysis of NO2 monitoring results

Figure 4.37 provides a comparison of the monitoring results with the relative ambient air quality guidelines using the categories described in Table 2.2.

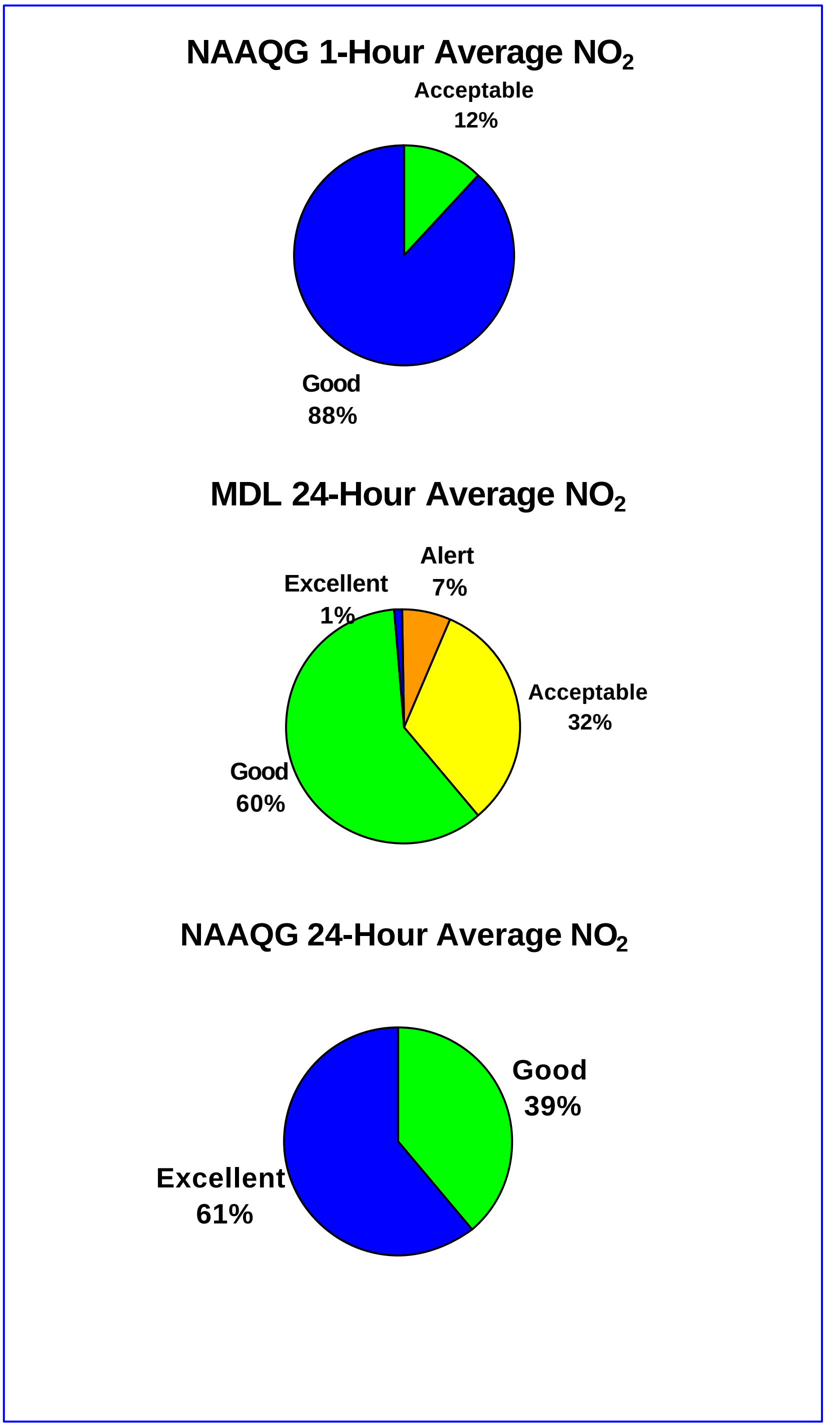


Figure 4.37: NO_2 monitoring results at Masterton compared to air quality categories for the period October 2002 to October 2003

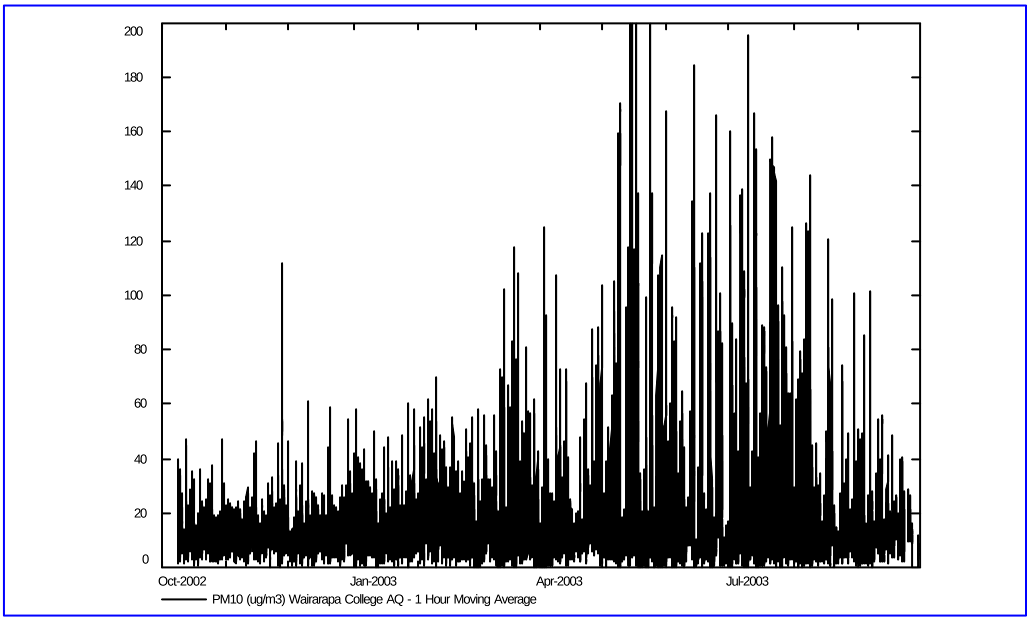
Figure 4.37 indicates that the NO_2 monitoring results at Wairarapa College compare favourably with the National Ambient Air Quality Guidelines. NO_2 concentrations fell mainly into the good to acceptable categories for the 24-hour NAAQG.

4.4.3 Particulate matter (PM_{10})

1-hour moving average

Figure 4.38 is a graph of the 1-hour moving average of PM_{10} concentrations at Wairarapa College for the monitoring period. There is no guideline value for 1-hour concentrations.

Figure 4.38: 1-hour moving average PM_{10} ($\mu g/m^3$) at Wairarapa College from 1/10/02 to 1/10/03



24-hour moving average

Figure 4.39 is a graph of the 24-hour moving average of PM_{10} concentrations at Wairarapa College for the monitoring period. The graph also indicates the 24-hour NAAQG of 50 $\mu g/m^3$.

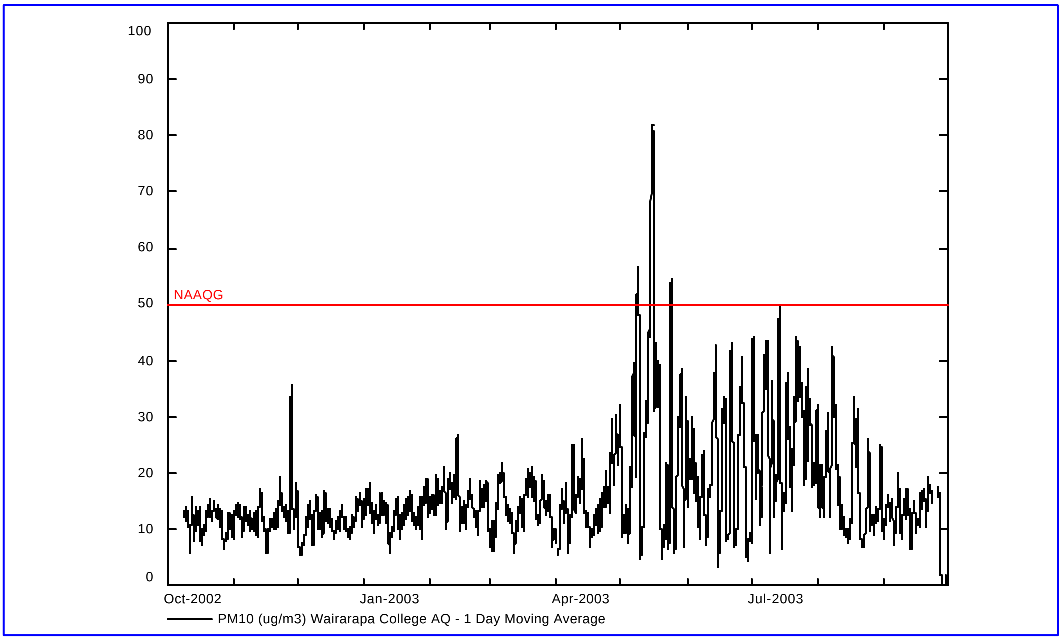


Figure 4.39: 24-hour moving average PM_{10} (mg/m³) at Wairarapa College from 1/10/02 to 1/10/03

The PM_{10} monitoring results indicate that there were 3 exceedences of the NAAQG guideline, all recorded during the winter.

Analysis of PM10 monitoring results

Figure 4.40 shows of the monitoring results compared with the relevant ambient air quality guideline using the air quality categories described in Table 2.2, and with the National Ambient Air Quality Guideline for PM_{10} (50 µg/m³).

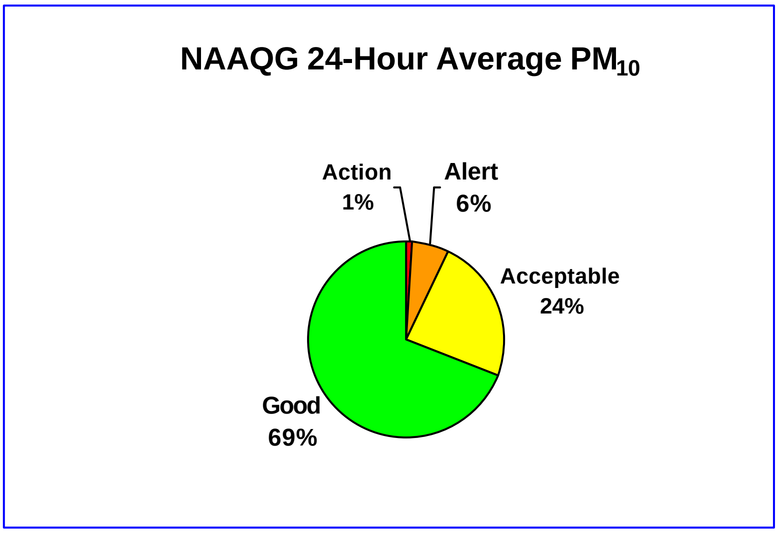


Figure 4.40: PM_{10} monitoring results at Masterton compared to air quality categories for the period October 2002 to October 2003

The particulate matter monitoring results at Masterton suggest that there are air pollution episodes during the winter that may of concern for community health.

4.4.4 Carbon monoxide (CO)

1-hour moving average

Figure 4.41 is a graph of the 1-hour moving average of CO concentrations at Wairarapa College for the monitoring period. The 1-hour NAAQG of 30 mg/m^3 for CO is not shown for scaling clarity.

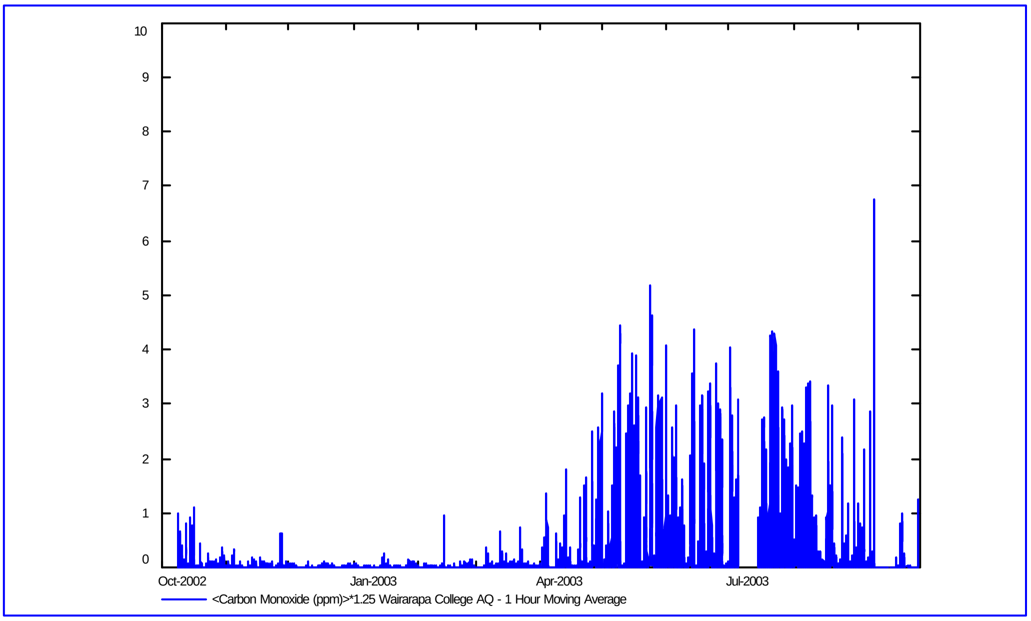


Figure 4.41: 1-hour moving average CO (mg/m³) at Wairarapa College from 1/10/02 to 1/10/03

8-hour moving average

Figure 4.42 is a graph of the 8-hour moving average of CO concentrations at Wairarapa College for the monitoring period. The graph also indicates the 8-hour NAAQG of 10 mg/m^3 and the maximum desirable level (MDL) of 6 mg/m^3.

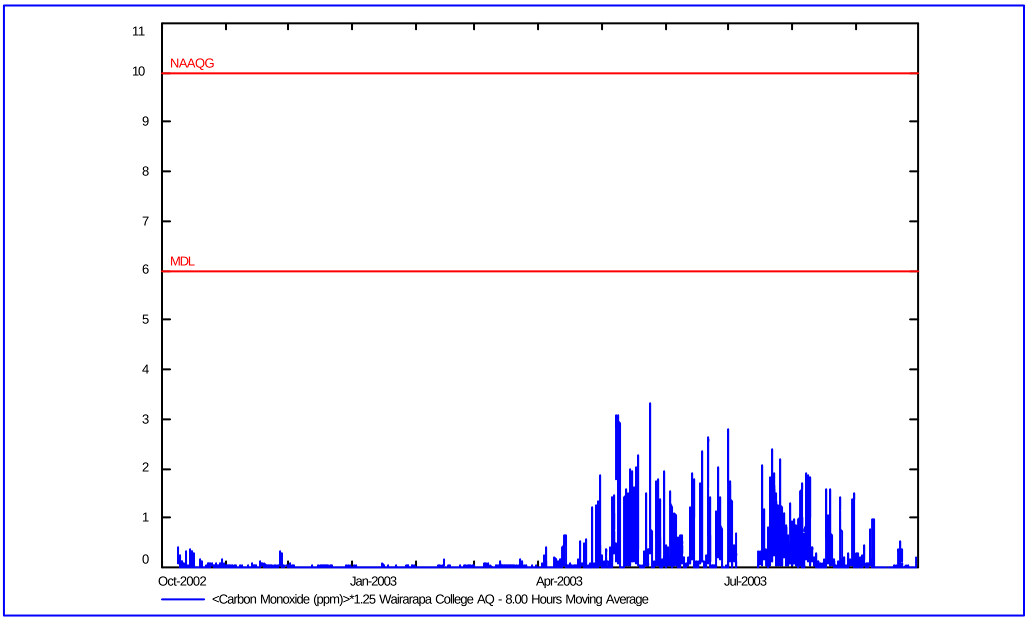


Figure 4.42: 8-hour moving average CO (mg/m³) at Wairarapa College from 1/10/02 to 1/10/03

Analysis of CO monitoring results

There were no exceedences of either the MAL or the MDL during the monitoring period. CO levels peaked at a concentration of 3.3 mg/m^3 at 2:04am on 25/5/03 for the previous 8 hours. This occurred after a cold calm night indicating that there was a significant temperature inversion present effectively trapping pollutants and enabling local ambient concentrations to build up.

Figure 4.43 illustrates the comparison of the monitoring results with the relative ambient air quality guidelines using the air quality categories described in Table 2.2.

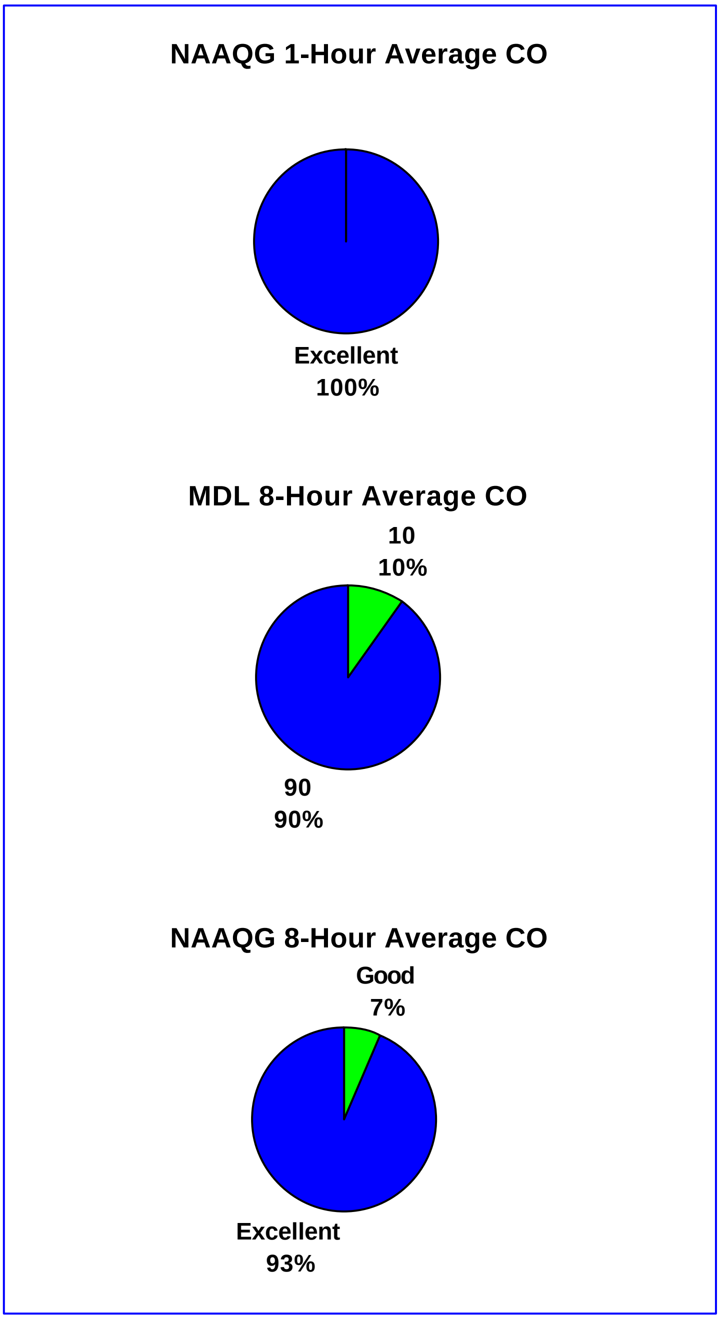


Figure 4.43: CO monitoring results at Masterton compared to air quality categories for the period October 2002 to October 2003

Overall, the levels of CO recorded during the monitoring period were not at concentrations that could be considered a concern to human health based on the current guidelines.

5. Conclusion

The results of the ambient air quality monitoring carried out in the Wellington Region over the past year (and in previous years) have indicated that the highest concentrations of air pollutants generally occurred during the winter. The reasons for the higher winter time air pollution levels are periods of cold, calm weather when pollutant concentrations increase in the local air mass rather than being dispersed, coupled with a greater quantity of emissions to atmosphere from combustion sources used for residential and commercial heating.

It is important to note that it is difficult to draw conclusions on the state of the air environment at a particular location based upon short-term monitoring. The following generalised comments must be treated with caution as only long term monitoring can assess air quality under a wide range of meteorological conditions and seasonal change.

Upper Hutt

A mobile ambient air quality monitoring station has been located at Trentham Fire Station in Upper Hutt since June 2000. The monitoring data confirms that the Upper Hutt area continues to be susceptible to higher air pollution concentrations during the winter, although there were no exceedences of the National Ambient Air Quality Guideline during the last winter.

Lower Hutt

The Council's first permanent ambient air quality monitoring station has been operating at Birch Lane in Lower Hutt since February 2001.

The results indicate that nitrogen dioxide levels were elevated during the winter in Lower Hutt. This is likely to be due to the combined effect of motor vehicle emissions and combustion emissions from residential and commercial heating, and with cold calm meteorological conditions. Peak levels occurred at similar times as those recorded at Upper Hutt, indicating the predominant influence of the weather on air pollution levels.

Wainuiomata

Fine particulate concentrations exceeded the National Ambient Air Quality Guideline on one occasion at Wainuiomata during the past winter. Peaks in air pollution occurred during cold calm weather conditions when dispersion of air pollutants was poor.

Wainuiomata continues to be susceptible to air pollution events during the winter and Greater Wellington will continue to monitor fine particles at the current site and is also looking to establish a meteorological site in the valley for air pollution studies. The use of solid fuel fires for domestic heating is thought to be the main source of air pollution in Wainuiomata.

Masterton

A permanent ambient air quality monitoring station was established at Wairarapa College in Masterton during October 2002. The highest air pollution levels in Masterton were recorded during winter with three exceedences of the National Ambient Air Quality Guideline for particulate matter (PM_{10}). Similar to Wainuiomata, the cause of the high particulate matter concentrations is likely to be emissions from domestic solid fuel fires.

References

Ministry for the Environment, October 1997. ***Environmental Performance Indicators: Proposals for Air, Fresh Water and Land***

NIWA, June 1995. ***National Ambient Air Quality Monitoring Network for New Zealand*** NIWA Report AK95001

Ministry for the Environment, 1994. ***National Ambient Air Quality Guidelines***

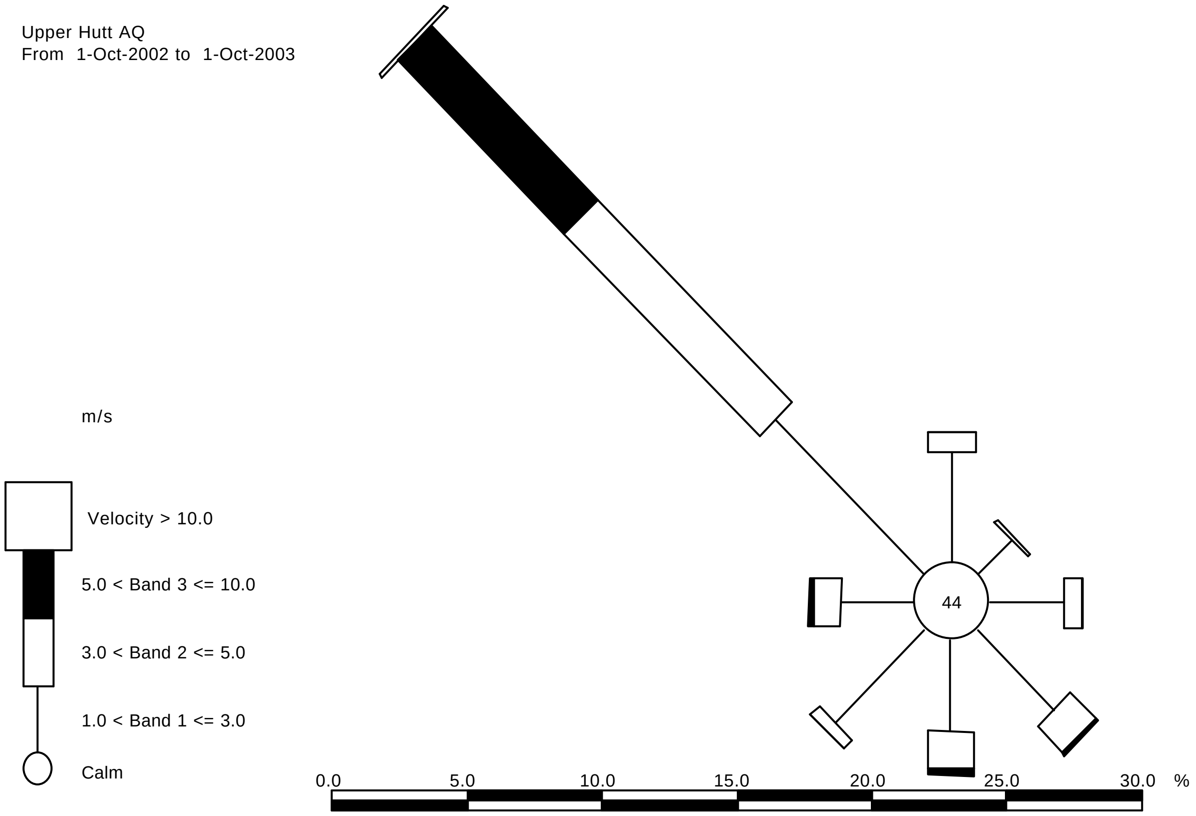
Ministry for the Environment, May 2002. ***Ambient Air Quality Guidelines***

Ministry for the Environment, December 2000. ***Good Practice Guide for Air Quality Monitoring and Data Management***

Wellington Regional Council, June 2000 *Wellington Regional Air Quality Monitoring Strategy 2000-2005* Wellington Regional Council Technical Report WRC/RINV-T-00/20.

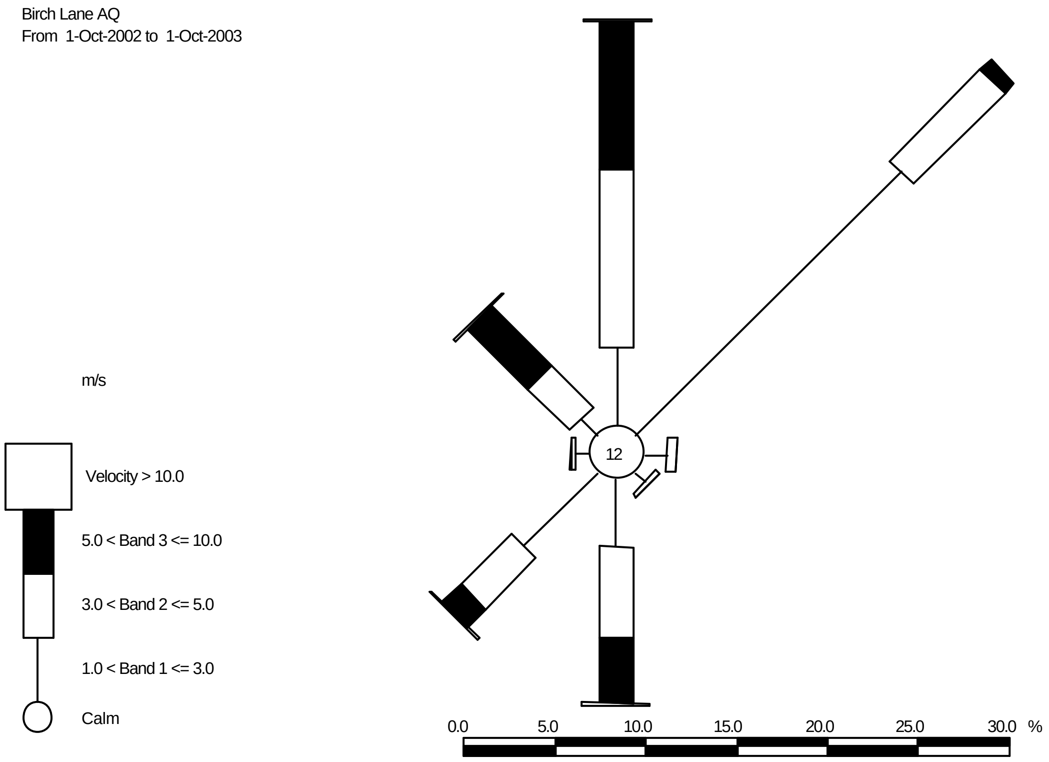
Appendix 1

Wind Rose for the Monitoring Period at Trentham Fire Station, Upper Hutt



Appendix 2

Wind Rose for the Monitoring Period at Birch Lane, Lower Hutt



Appendix 3

Wind Rose for the Monitoring Period at Wairarapa College, Masterton