NERMN Air Monitoring 2010

Prepared by Shane Iremonger, Environmental Scientist

Environment Bay of Plenty
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Whakatane
NEW ZEALAND

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Working with our communities for a better environment
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Cover Photo:

Meteorology is often a dominant controller on ground level concentrations of contaminants. Here is a photo of the Coastlands subdivision obscured by radiation fog, it is under these atmospheric conditions that contaminant concentrations are often elevated due to inversion driven confinement. This photograph is taken (July 2008) from an ancient pa site above Whakatane, named Te Papaka (The Crab) after a Ngati Awa ancestor who, according to his wife, resembled a crustacean.

Acknowledgements

Glenn Ellery and Charl Naude for the accurate preparation of the data sets is acknowledged, as are the efforts of the entire Data Services team, in the collection of the ambient air quality data.

The word processing skills of Rachael Musgrave and Kerry Heitia, in the creation of this document.

Executive summary

Environment Bay of Plenty is required to undertake monitoring activities as part of its statutory responsibilities under the Resource Management Act 1991 (RMA) and the Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and Other Toxics) Regulations 2004.

This report includes a review of the Environment Bay of Plenty Air NERMN programme. It reports on air quality data collected to date, it also includes a review of the monitoring programme and provides guidance and recommendations as to the future direction of this programme.

Particulate matter is an issue in Rotorua and steps have been undertaken to address this problem. Regional investigative monitoring (coupled with the long-term monitoring) should continue to be undertaken in order to identify any other 'hotspots' within the region and to comply with NES-AQ requirements. Adverse health effects from particulate exposure are now better understood and thus this contaminant should be the main focus of monitoring for the next five year period. Improvements in monitoring equipment should also be investigated to ensure high capture rates are maintained.

Monitoring results for carbon monoxide are well below the National Environmental Standard but a need for continuing vigilance around areas impacted by traffic and/or residential combustion remains, because of the potential for continuing increases in emissions due to projected population growth.

Due to the exceedances of sulphur dioxide recorded to date in the Mount Maunganui industrial/port area monitoring should continue at the Totara Street site. This will improve the understanding of the ambient levels of this contaminant, and will add value to any further investigative work at both a regional and national level.

Concerns about possible health effects of hydrogen sulphide will only be resolved through long term health studies and these will continue to need supporting ambient data. To date the historical data shows no long-term trends which are discernable, this reflects the nature (episodic in many cases) of the geothermal source and the effects of meteorology within the Rotorua urban area.

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Part 1: Introduction

Environment Bay of Plenty is required to undertake monitoring activities as part of its statutory responsibilities under the Resource Management Act 1991 (RMA) and the Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and Other Toxics) Regulations 2004.

The current Natural Environmental Regional Monitoring Network (NERMN) is based around a regional network of monitoring sites designed for regional state-of-the environment monitoring, documentation and reporting. Natural environment monitoring determines the overall regional impact of activities on environment quality.

This report includes a review of the Environment Bay of Plenty Air NERMN programme. It will report on air quality data collected to date, it will also include a review of the monitoring programme and provide guidance and recommendations as to the future direction of this programme.

1.1 Requirements of RMA and regional plans

The purpose of the Resource Management Act (1991) is to promote sustainable management of natural and physical resources. Environmental monitoring is a specific requirement of the Act. Section 35 directs Regional Councils to *"gather such information, and or undertake or commission such research, and monitor the state of the whole or any part of the environment of its region or district to the extent that is appropriate, as is necessary to carry out effectively its functions under the Act"*.

In December 2003 the Bay of Plenty Regional Air Plan was made operative. The purpose of this plan is to enable Environment Bay of Plenty to promote the sustainable management of the Bay of Plenty air environment. Sustainable management is defined in section 5 of the Act as:

"Managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic and cultural wellbeing and for their health and safety while –

(a) *Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*

(b) *Safeguarding the life-supporting capacity of air, water, soil and ecosystems; and*

(c) *Avoiding, remedying or mitigating any adverse effects of activities on the environment."*

Section 5.5 of the Air Plan outlines plan monitoring and review. Information for plan monitoring will be drawn from a range of NERMN monitoring programmes including data collection and the resulting analysis performed and documented in this report.

1.2 Report objectives

This report forms the assessment of the current ambient air quality monitoring programme for the Bay of Plenty region. The objectives are briefly outlined below:

(i) To assess air quality changes in Bay of Plenty between 1997 and the end of 2009 and compare against the National Environmental Standard for Air Quality (NES-AQ).

(ii) To compare current trends with earlier assessments.

(iii) To provide information to assist in reviewing the current monitoring schedule.

Part 2: National Environmental Standard

2.1 Overview

A new Regulation for ambient air quality in New Zealand was promulgated in September 2004, as a National Environmental Standard (NES-AQ)[1] under s43 of the Resource Management Act 1991. The NES-AQ specifies health-based limits for ambient air concentrations of fine particulate (PM_{10}), carbon monoxide, nitrogen dioxide, ozone and sulphur dioxide. The Regulation also specifies requirements for monitoring of these pollutants, in the event that the standards are breached. It establishes an air quality management regime, based on controls over the issuing of resource consents in those areas where the limits are exceeded, or likely to be exceeded.

A key element of this control regime is the designation of "airsheds" under sub-clause 14 of the Regulation. These are to be specified by the Minister for the Environment by a notice in the Gazette. The term "airsheds" is only loosely defined in the Regulation, and it has since been suggested that the term Local Air Management Area (LAMA) gives a better indication of the function and purpose of these areas hence the term LAMA is used.

Regional councils were invited to nominate specific LAMA's for their region by 1 July 2005.

2.1.1 Rotorua local air management area

In response to the Ministry for the Environment's request to nominate Local Air Management Areas (LAMA), Environment Bay of Plenty has currently designated only one LAMA for the Bay of Plenty region, this is the Rotorua LAMA[2].

The location and extent of this area was initially based on local air quality monitoring data, air emission inventories, air discharge consents, council staff knowledge, geophysical, population and meteorological information. The extent of the LAMA has more recently been qualified by a detailed airshed modelling exercise[3] (Fisher et. al., 2007).

During winter the Rotorua basin is prone to ground based radiation inversions and cooling katabatic winds causing a confinement of the airmass above the city. On other occasions during winter, settled conditions associated with post frontal ridging and the emission outputs from domestic heating result in elevated particulate concentrations.

To better understand the distribution of contaminants in the area several additional monitoring sites have been installed.

[1] Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations 2004 SR 2004/309 (2004/433 and 2005/214).
[2] New Zealand Gazette, 2005, *Bay of Plenty Regional Airshed Notice,* New Zealand Gazette, No. 141, 25 August 2005.
[3] Fisher, G. et. al., 2007, *Rotorua Airshed Modelling Investigation*, Client report, Endpoint Ltd., Auckland

2.2 Review

A ministerial review of the PM_{10} regulations in the air quality standards is currently underway. The following regulations are to be reviewed:

- Regulations 13 – 19 and Schedule 1 of the Resource Management (National Standards Relating to Certain Air Pollutants, Dioxins and other Toxics) Regulations 2004.

The Minister has identified three aspects of the PM_{10} regulations in the air quality standards that require attention. First, the number of permitted exceedances needs review. In 2003, the Ministry for the Environment proposed an ambient PM_{10} standard of 50 micrograms per cubic metre as a 24-hour average with five exceedances permitted per year. This proposal was reduced to one exceedance after consultation with regional councils; five being that permitted in Australia to allow for bushfires and this being considered unnecessary for New Zealand. The Minister wishes to review this decision.

Second, the target timeline of 2013 is to be reviewed. Is it achievable? What are the costs and benefits of still achieving it?

Third, the Minister considers the compliance aspects of the air quality standards inequitable. The air quality standards have significant implications for industry because, after 2013, regional councils cannot grant consent for discharges in over-allocated airsheds. The air quality standards may unfairly penalise industry because domestic heating, not industry, is the primary source of this pollution.

Environment Bay of Plenty has prepared a submission with comments on the three above mentioned topics. The Council also liaised with the local territorial authorities regarding this submission.

A Technical Advisory Group has been established to undertake this review and the first stage was reported back to Cabinet in February 2010.

Part 3: Monitoring sites

3.1 Monitoring methods

The MfE Good Practice Guide[4] and the NES-AQ regulations[1] recommend a set of methodologies for ambient air quality monitoring. These are as shown in Table A.1 and are implemented in Environment Bay of Plenty's monitoring programme.

The current monitoring sites maintained by Environment Bay of Plenty are listed (along with metadata) in Table 3.1.

[4] Ministry for the Environment. 2009. *Good Practice Guide for Air Quality Monitoring and Data Management 2009.* Wellington: Ministry for the Environment.

*Table 3.1 Reported monitoring site details (Sites marked with * are those for which detailed analysis is presented in Section 4).*

Site Title	Pererika*	Edmund Road*	Ngapuna*	Ngongotaha	Te Ngae	Pongakawa*	Otumoetai*
Location	Pererika Street, Rotorua	Corner of Linton Park Recreational Reserve (adjacent to 51 Edmund Road), Edmund Road, Rotorua.	Located within the grounds of Sealed Air (Cryovac Limited), Te Ngae Road, Rotorua.	A & M MacKechnie 3 Paraone Street Ngongotaha	Te Ngae Road, Rotorua	Pongakawa Bush Road	Otumoetai Road, Tauranga
Land/site owner	Pukeroa Oruawhata Trust	Rotorua District Council	Sealed Air (Cryovac Limited)	A & M MacKechnie	NIWA depot building, Te Ngae Road	Private land owner	Otumoetai Primary
Site height above sea level	280 metres (±6 m)	290 metres	288 metres	284 metres	320 m	102 metres (±6 m)	65 metres (±6 m)
Region	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty
Co-ordinates	U16: 943 353 (NZMG 2794248 6335478)	U16: 9185, 3577 (NZMG 2791852 6335771)	U16: 9784, 3479 (NZMG 2797841 6334793)	U15: 9206, 4256 (NZMG 2792067 6342560)	V15: 9549 3456 (NZMG 2795488 6334955)	V15: 1732 6349 (NZMG 2817320 6363490)	U14: 8675 8680 (NZMG 2786835 6386414)
Directions to site	The site is situated on the Pukeroa Oruawhata Trust (ex Telecom Works Depot) property, off Pererika Street, Rotorua.	Travelling north along Edmund Road, the site is located on the right-hand side in Linton Park Recreational Reserve, adjacent to residential property 51 Edmund Road.	Travelling along Te Ngae Road, turn into Sealed Air (Cryovac), where the site is located at the rear of the facilities. Sign in at reception before entering.	Turn of Ngongotaha Road into Wikaraka Street, then left into Paraone Street. The site is located No. 3 (second on right) Paraone Street.	Located in the NIWA depot building	Travel 50 kilometres along Thornton Road/State Highway 2 towards Tauranga. Turn left at Pongakawa School Road and travel 1.5 km before turning left into Old Coach Road. Travel 1.5 kilometres until; reaching Pongakawa Bush Road then travel 3.9 kilometres before turning left into a gate marked with Dairy Shed number 21565. Park at the milking shed and walk 160 m north to the site.	Travel along Otumoetai Road, Tauranga to the corner of Darragh and Otumoetai Roads. The shed is located in the south eastern corner of the school field.
Contaminant monitored	PM_{10}	PM_{10}	CO & PM_{10}	PM_{10}	H_2S	PM_{10}	CO, PM_{10}
Monitoring objectives	Long term PM_{10} monitoring in residential area. Assess the levels of H_2S in a selection of areas throughout Rotorua. Sites will also assist in the monitoring exposure levels of the people in that area.	Long-term residential and commercial PM_{10} monitoring.	Long-term commercial PM_{10} and CO monitoring. Primarily initiated as a response to complaints, this site now assists in monitoring commercial PM_{10} contribution to Rotorua LAMA.	Investigative residential and commercial PM_{10} monitoring.	Assess the levels of H_2S in areas that are likely to have higher emissions from several directions. Sites will also assist in the monitoring exposure levels of the people in that area.	Long term PM_{10} monitoring in background area.	Long term CO and PM_{10} monitoring in residential area.
Site type	Urban PM_{10} site	Residential and Commercial PM_{10}	Primarily commercial with residential & traffic contribution.	Residential & Commercial PM_{10}	Natural (ambient) H_2S	Background PM_{10} site	Urban CO, PM_{10}
Equipment	FDMS TEOM	FDMS TEOM	FDMS TEOM	Partisol 2025	ML9850 with thermal oxidiser.	Partisol 2025	FDMS TEOM, ML9830
Site topography	The site is located in a large yard with a row of single storey buildings 100 m to the south and another group of buildings 250 m to the south east. Amohau Street is located 50 m to the north. The yard is located on the edge of a residential area.	Situated on gently undulating area within Linton Park Recreational Reserve (Western Heights). Commercial area to the east, and residential surrounding the site.	Situated on a flat area in Ngapuna industrial area, with Lake Rotorua about 1km to the north-west.		Situated on a flat area about 360 m north of the Rotorua racecourse.	Large flat paddock with surrounding rolling countryside.	Situated on a flat area within the Otumoetai suburb, which is an elevated region to the west of Tauranga City.
Location and direction of major sources	Residential home heating surrounds the site.	Residential source direction is 360 degrees, with some commercial source from directional arc 40 degrees to 130 degrees.	Industrial/Commercial source is 360 degrees, with some traffic contribution from Te Ngae Road 125 m to the south-east. Also, domestic source from Lynmore to the south-east.	Residential source direction is 360 degrees, with commercial source direction between 180 and 280 degrees arc.	Natural, multiple sources, major source are the Whakarewarewa area to the south and active geothermal area on the lake margins to the northwest.	Rural paddock sources. 360 degrees as possible source direction.	Source direction is 360 degrees. Residential properties in the clockwise arc from 0 to 180 degrees. Otumoetai Road is located in the immediate vicinity in the arc from 181 to 359 degrees.
Planned development of site	Permanent.	Permanent Site.	Semi permanent – Possible relocation to other areas within Rotorua city for concentration mapping.	Short-term investigative site.	Semi permanent – Possible relocation to other areas within Rotorua City for concentration mapping.	Permanent	Permanent

Site Title	Morland Fox Park	Totara Street*	Maru Street*	King Street, Whakatane.*	Galway Street, Kawerau.
Location	Located within the grounds of Morland Fox Park, Greeton, Tauranga	Corner Waimarie and Totara Street, within Tauranga City Council compound.	Located within the Ballance depot at Maru Street, Mount Maunganui.	Adjacent to Maori Wardens Office, 7a Victoria Ave. Whakatane	Located 80m north east of the Galway Street – Fox Street intersection.
Land/site owner	Tauranga City Council	Tauranga City Council	Ballance	Whakatane District Council	Kawerau North School.
Site height above sea level	34 metres	3 metres	4 metres	10 metres	~25 metres
Region	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty
Co-ordinates	U14: 8625, 8093 (NZMG 2786259 6380936)	U14: 9138, 8838 (NZMG 2791384 6388383)	U14: 9209, 8823 (NZMG 2792093 6388235)	W15: 5989, 5247 (NZMG 2859898 6352477	V16: 3515, 3990 (NZMG 2835158 6339903)
Directions to site	Travelling along Cameron Road (Greeton), turn into Oban Road. Proceed to the end of Oban Road where access to Morland Fox Park. The monitoring station is directly across the soccer fields.	Located at Waimaie/Totara Streets intersection.	Travelling along Hull Road, turn into Maru Street. Proceed along Maru Street for approximately 700 m, where the sign-posted Ballance depot is located on the left. Turn into the depot, and the monitoring station is located adjacent to the small office/staff room building.	Located east of King Street, behind Kopeopeo shops, adjacent to the Maori Wardens Office on the alley-way,	Located in the pool shed of the Kawerau North School, access to the site is through the main school entrance.
Contaminant monitored	PM_{10}	SO_2	SO_2	PM_{10}	PM_{10}
Monitoring objectives	Long term residential PM_{10} monitoring.	Assess commercial contribution, and vehicle peak emissions at busy intersection in Mount Maunganui.	Assess commercial contribution in Mount Maunganui, specifically helpful to triangulate specific sources.	Long-term residential area PM_{10} monitoring.	Investigative residential PM_{10} monitoring
Site type	Urban PM_{10}	Commercial and peak traffic SO_2	Commercial, traffic and point source SO_2	Urban/Commercial PM_{10}	Urban PM_{10}
Equipment	FDMS TEOM	EC9850	EC9850	FDMS TEOM	Partisol 2025
Site topography	Open park area to the immediate north, with residential surroundings.	Flat area with empty paddock to east, busy road running (Totara Street) north/south to the west, and surrounded by industrial activity.	Flat area with empty paddock to south, busy site access way immediately north. Surrounded by industrial activity, primarily agri nutrients storage and transportation.	Situated on a flat area with a carpark to the north, and surrounding residential and commercial.	Situated on a flat area. Swimming pool is nearby along with a couple of 5m trees 12m to the north east.
Location and direction of major sources	Residential source direction is 360 degrees.	Busy road (Totara Street) to the west from 190 degrees to 350 degrees, and commercial source direction is 360 degrees.	Commercial source direction is 360 degrees. Primary point sources located to the south and south-west.	Residential and commercial source direction is 360 degrees.	Surrounded generally by residential development. Tasman pulp mill is 1.5km to the north east.
Planned development of site	Permanent site.	Semi-permanent site.	Semi-permanent site.	Permanent site.	Short term investigative site.

Part 4: Monitoring results

4.1 Environmental Performance Indicators (EPI)

Environmental performance indicators (EPI) for air quality are used to measure and report on the state of our air environment.

The air indicators selected (Table 4.1) are 'state' indicators. State indicators provide a picture of the current state of the environment judged by comparing the monitoring results to MfE standard values (Table 4.2).

Table 4.1 Performance Indicators

Category	Maximum Measured Value	Comment
Excellent	<10% of the standard	Of little concern, if maximum values are less than a tenth of the guideline, average values are likely to be much less.
Good	10 – 33% of the standard	Peak measurements in this range are unlikely to impact air quality.
Acceptable	33 – 66% of the standard	A broad category, where maximum values might be of concern in some sensitive locations but generally at a level which does not warrant dramatic action.
Alert	66 – 100% of the standard	A warning level, which can lead to exceedences if trends are not curbed.
Action	Exceeds the standard	Exceedences of the standard are a cause for concern and warrant action if they exceed the NES-AQ permissible occasions.

Table 4.2 National Environmental Standards for ambient air quality.

	Standard value	
Contaminant	**Threshold concentration**	**Permissible excess**
Carbon monoxide	10 milligrams per cubic metre expressed as a running 8-hour mean.	One 8-hour period in a 12-month period
Sulphur dioxide	350 micrograms per cubic metre expressed as a 1-hour mean.	9 hours in a 12-month period
	570 micrograms per cubic metre expressed as a 1-hour mean.	Not to be exceeded at any time
PM_{10}	50 micrograms per cubic metre expressed as a 24-hour a mean.	One 24-hour period in a 12-month period
Nitrogen dioxide	200 micrograms per cubic metre expressed as a 1-hour mean.	9 hours in a 12-month period
Hydrogen sulphide [a]	7 micrograms per cubic metre expressed as a 1-hour mean.	-

a – value is based on an odour nuisance level and is a NZAAQG value[7].

4.2 Quality assurance

All monitoring sites are operated by Environment Bay of Plenty. The operation of these sites is undertaken in accordance with the Environmental Data Services Field Practice Manual[5], and the MfE guidance document[4]. Operation includes maintenance of the site and instrumentation and calibration of the monitoring equipment.

The Environmental Data Services Air Quality Office Practice Manual[6] outlines procedures for the provision of quality assured data.

As a form of external audit on the instrument operation an inspection programme is conducted using Ecotech Pty Limited every 18 months. Ecotech is an ISO 9001 and NATA accredited company. Reports from Ecotech provide calibration, service results and comments regarding the operation of the site and instrumentation.

4.3 Monitoring results

The detailed results reported in this section are from the air monitoring sites marked with an asterisk in Section 3. Section 4.3.10 will cover discussion on data from sites where the period of record is to short to undertake meaningful time series analysis. For the purpose of this report the data will be reported in relation to the NES-AQ, however where the contaminant is not covered by the standards then the MfE guidelines[7] will be used for comparison.

Each report contains a discussion on data trends and a page containing graphical analysis (with a PM_{10} focus).

[5] Environment Bay of Plenty, 1998, *Field Practice Manual*, Internal document.
[6] Environment Bay of Plenty, 1999, *Air Quality Office Practice Manual*, Internal document.
[7] MfE, 2002, *Ambient Air Quality Guidelines,* Air Quality Report no, 32, ME number 438.

4.3.1 Pererika Street, Rotorua

Location:

This site is impacted by two main anthropogenic sources. The Amohau Street roadway (AADT[8] ~14,000), 20 m to the north and the largely residential area several hundred metres to the south. Immediately to the south is a sealed yard and reserve land. Immediately to the east is the Rotorua Boys High School, with large sport fields and a gas fired central heating system. The developed area to the north east is largely occupied by businesses, with a significant geothermal heating profile.

PM_{10}:

For the majority of time the PM_{10} values are measured in the 'Good' air quality category. However during the winter months, air quality reduces into the 'Acceptable' and 'Alert' categories. For less than one percent of the time the air quality is within the 'Action' category. Occasional exceedances of the PM_{10} NES-AQ do occur at this site during the winter months. On average 2.3 exceedances have occurred per year with a maximum number of 6 recorded in 1998. This seasonal increase is reflected in the annual and diurnal plots, with winter time being the time of elevated concentrations.

On a daily scale the winter time plot shows the dominating effect of domestic heating sources, with a noticeable increase in the morning on top of the traffic contribution and then a four fold increase on summer time levels being recorded during the evening as emissions from wood burners impact the site. These source patterns are reflected in emission inventory[9] and modelling investigations[3] for the Rotorua LAMA.

The 12 years of record shows the variability in air quality as a result of cycles in meteorological patterns. The emission source profile for Rotorua over this period would not have changed dramatically as population is generally stable and the impact of the NES woodburner regulations since 2004 would only be minor and not detectable with the current monitoring regime. Major positive shifts in air quality are expected to occur with the implementation of the Rotorua Airshed Action Plan initiatives.

CO:

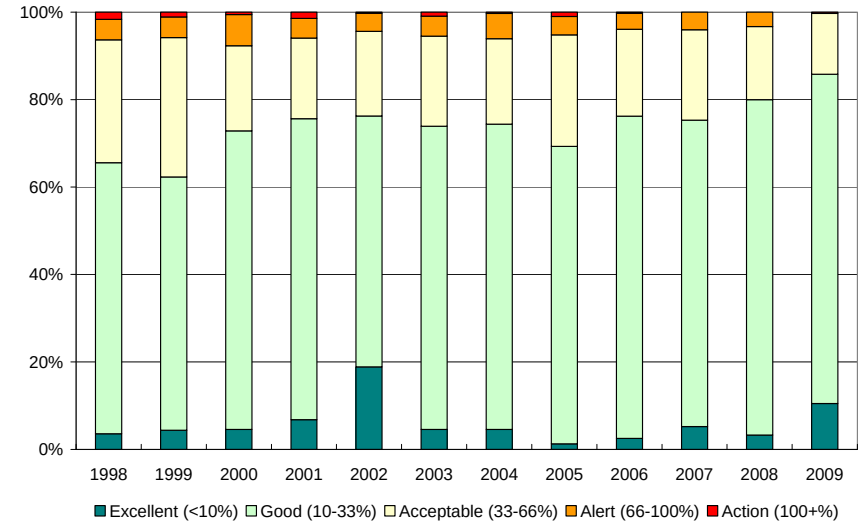
Carbon monoxide monitoring ceased at this site in 2007, ten years of data had been collected and values were well below the MfE standard. Carbon monoxide values recorded at Pererika Street, exhibit the same trends as the PM_{10} record, with a pronounced increase during the winter months. Values are higher than at the Otumoetai monitoring site in Tauranga, which could be due to differences in local meteorological conditions, vehicle densities, and the proximity to Amohau Street, which is 20 m to the north of this site. The wind data shows the prevailing wind for this area is from the southwest quarter suggesting that CO emissions from vehicles often get transported away from the sampling inlet.

The seasonal diurnal data for Pererika shows the influence of vehicle produced CO in the time period from 07:00 to 10:00 for all seasons (although autumn and winter are more predominant). Levels are generally depressed during the day (probably the result of wind conditions causing increased mixing) with noticeable increases from 17:00 particularly in the autumn and winter months where domestic heating would be a significant producer of carbon monoxide.

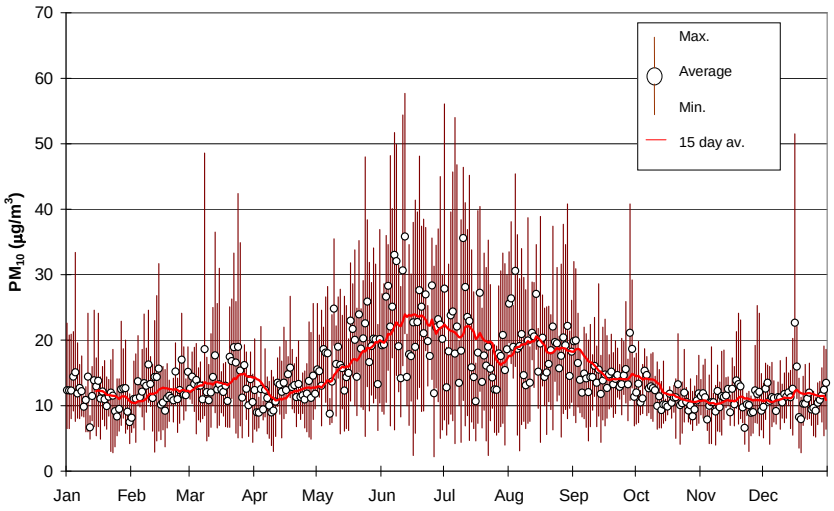
[8] Annual average daily total number of vehicles.
[9] Iremonger, S. & Graham, B., 2006, Rotorua Air Emission Inventory, Environmental Publication 2007/02, Environment Bay of Plenty, p45

Pererika Street, Rotorua.

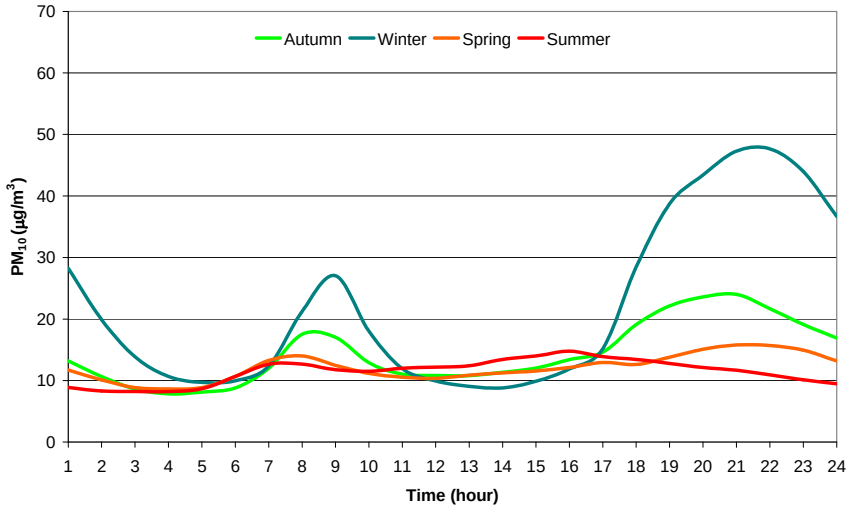
Environmental Performance Indicator PM_{10}.



Annual combination plot (1998-2009).



Seasonal diurnal plot.

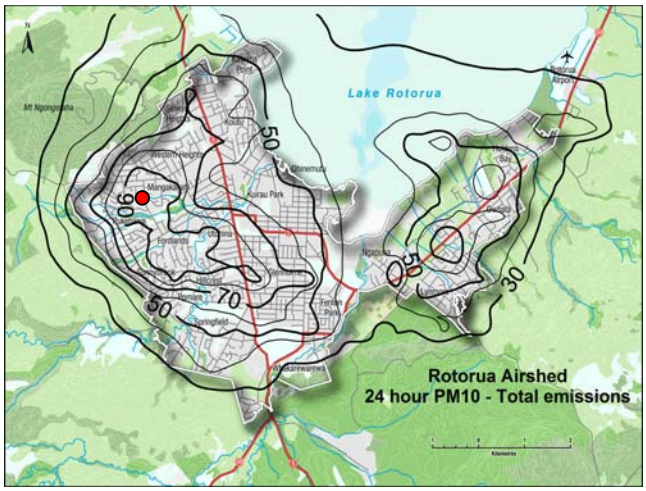


4.3.2 Edmund Road, Rotorua

Location:

This site is located close to Edmund Road, which is a main residential road linking the Western suburbs. The site is surrounded by dense residential areas although the area immediately to the south of the site is punctuated by a small stream and associated reserve land. The site is more elevated than the other two Rotorua sites as in the west the land rises to the base of Mount Ngongotaha. This elevation difference between this area and lake edge promotes light drainage flows under settled conditions. The effect of this meteorological phenomenon is highlighted in the airshed modelling exercise[3] although the scale of its effect on particulate movement is only minor.

The modelling exercise also confirmed that the location of this site (red dot) meets the NES-AQ requirement of 'worst case' monitoring location (see figure below).



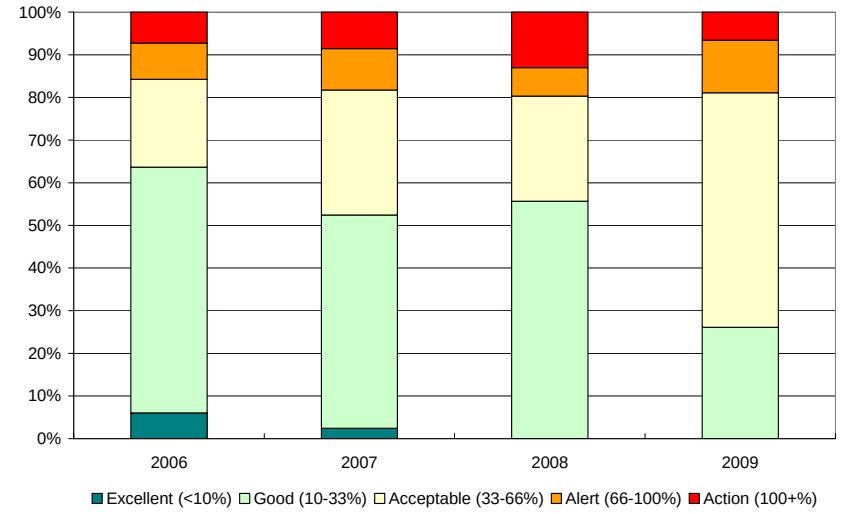
PM_{10}:

The period of record covers several years now with records beginning in March 2006. The annual results to date show large numbers of exceedances (23, 26, 41 and 23 for 2006, 2007, 2008 and 2009 respectively) of the standard during the 'heating season'[10]. For ~80% of the time the air quality is of an 'Acceptable' or better quality. The maximum recorded 24hr concentration is 162$\mu g/m^3$ and the strong seasonal pattern is shown in the annual plot. The same seasonal pattern is shown in the diurnal dataset with the summer trace showing the very slight influence of traffic. The spring trace shows the effect of the end of heating season as concentrations increase in the early evening. Autumn has a bimodal pattern with evening domestic heating emissions now being recorded with a morning peak as residents relight their fires. The winter trace shows the full effect of domestic heating with a marked peak present in the morning followed by a return to elevated base levels during 12:00 to 16:00 as the emission reduce, turbulence develops and mixing occurs. This situation reverses quickly around 17:00 as fires are lit and concentrations continue to increase as the mixing height reduces and stability in the lower airmass occurs.

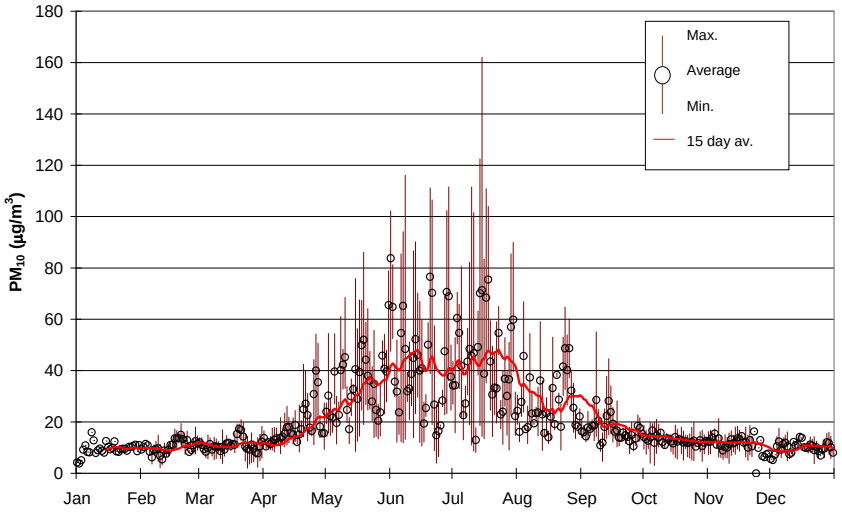
[10] Iremonger, S. & Graham, B., 2006, Rotorua Domestic Heating Survey, Environmental Publication 2006/14, Environment Bay of Plenty, p29.

Edmund Road, Rotorua

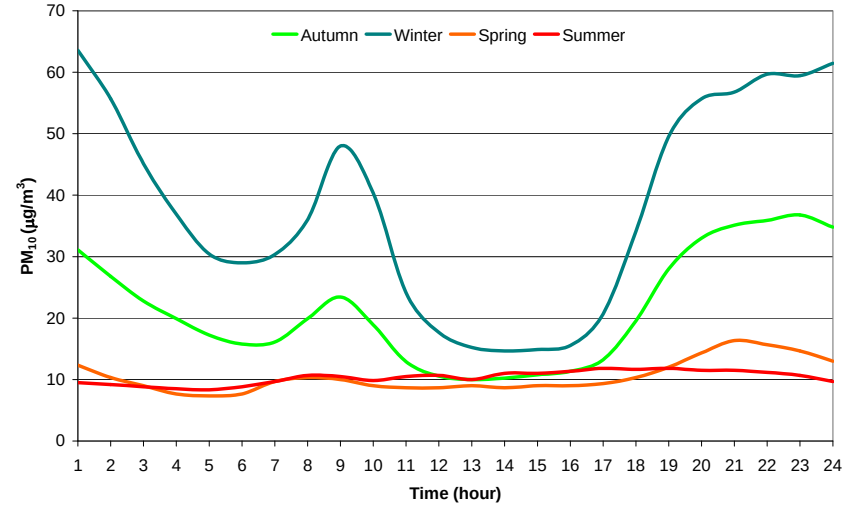
Environmental Performance Indicator PM_{10}.



Annual combination plot (2006-2008).



Seasonal diurnal plot.



4.3.3 Ngapuna, Rotorua

Location:

The monitoring site is located in the north-eastern corner of the Ngapuna Industrial Area.

The Ngapuna Industrial Area is a mixture of industrial and residential land use covering approximately 1 km^2. The area is bounded to the east by State Highway 30 which has an AADT volume of ~18,000 vehicles, of which ~5% is classed as heavy. To the south and west the area is bounded by the Puarenga Stream and Sulphur Bay of Lake Rotorua. To the immediate north is farmland which is covered in pasture and during summer, maize crops. 400 m further north is the southern boundary of the Owhata West residential subdivision.

Land use is predominately light to medium industry, but is punctuated by a centrally located 0.1km^2 area occupied by the Ngapuna residential subdivision centred around Hona Road and Hurunga Avenue. The Census 2006 usually resident population count for this subdivision was 270, with a calculated deprivation index of 10 (most deprived).

Industry is mixed, but has a focus on the primary and secondary timber industries. Timber processing plants are the largest operators and current air discharge consents are held by Tachikawa Forest Products (NZ) Ltd and McAlpines (Rotorua) Ltd and the ex-Panahome site currently owned by Hume Pine Ltd.

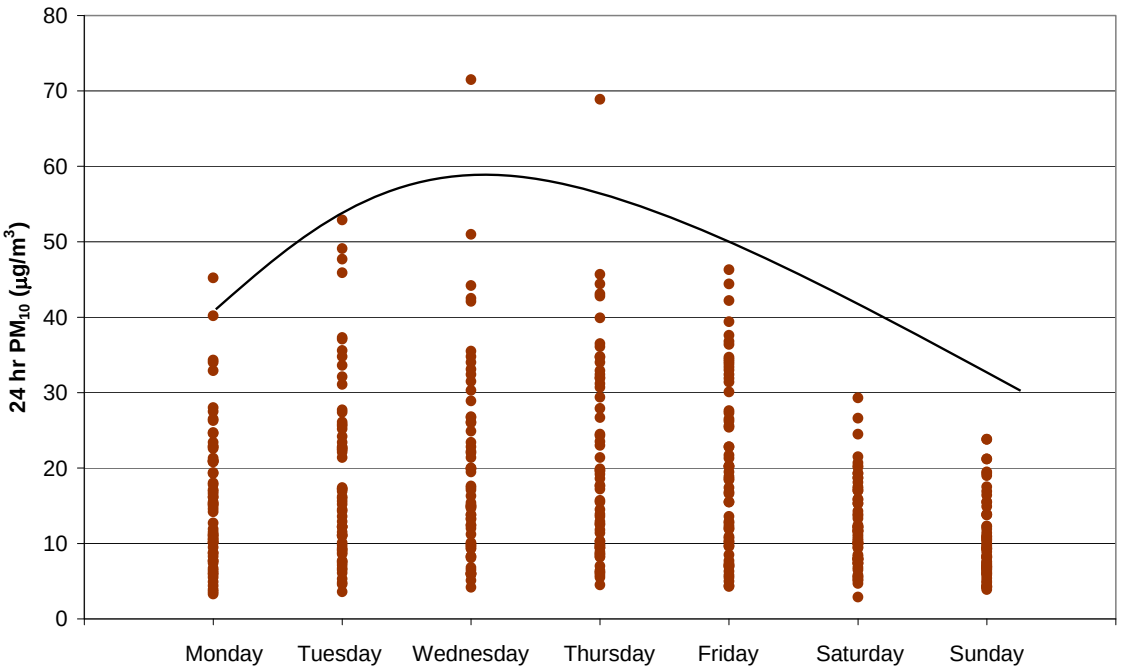
PM_{10}:

A detailed report of data recorded and other information collected is summarised in a recent environmental report[11]. An extensive commercial site nuisance dust survey has just been completed and will be reported in the very near future.

The period of record at this monitoring site is only short with records beginning in 2007. Greater than 90% of the time for 2008 the air quality measured in relation to fine particulate matter was acceptable or better. However the annual plot for 2008 and 2009 shows a number of exceedances of the NES-AQ. Concentrations presented often only just exceed the standard value of 50$\mu g/m^3$ and are typically well below the levels recorded at the peak neighbourhood site in Edmund Road on the western side of Rotorua City (90%ile = 50$\mu g/m^3$, max. = 162$\mu g/m^3$). The diurnal profile is more subdued than the residential site data. Spring and summer show the higher values with peaks occurring in the afternoon as wind speeds increase and material from throughout the area is suspended.

[11] Iremonger, S.D., 2009, *Ngapuna Air Quality Monitoring report 2008*, Environment Bay of Plenty, Environmental Publication 2009/02, p42.

Week day patterns also exist (see graph below) and provide some insight into the source of material collected.

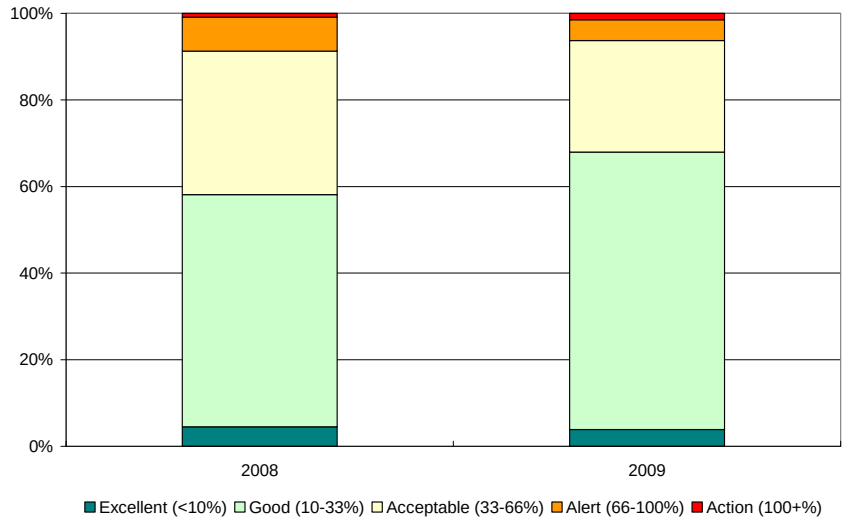


The analysis of the more recent monitoring data suggests a number of sources are contributing to the PM_{10} exceedances recorded. The traditional main sources - domestic heating, traffic and consented industries have been quantified and modelled[3,12] with results showing exceedances under worst case conditions. However these were determined for a wintertime period and the contributing source mixture will be different during the summer which is when these exceedances have been recorded.

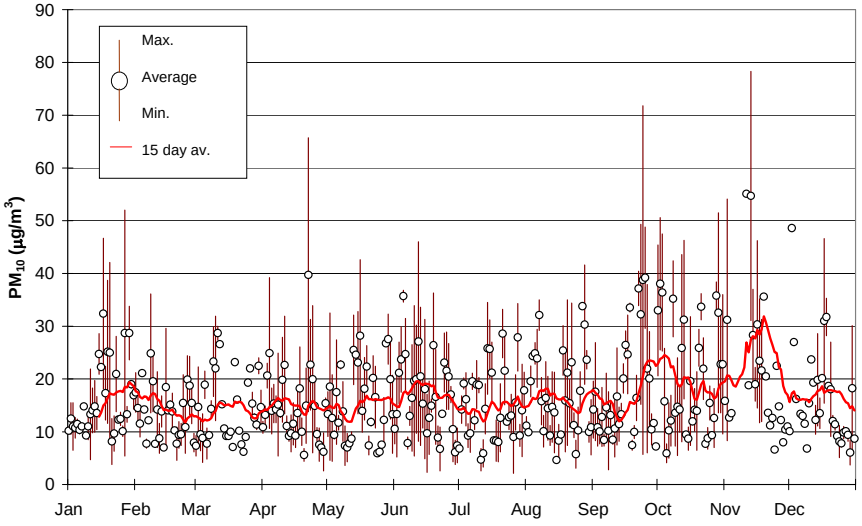
[12] Iremonger, S.D. & Graham, B, 2008, *Industrial Emissions in the Rotorua LAMA,* Environment Bay of Plenty, Internal Memorandum, File number 0240 01 I01, 26 February 2008, 8p.

Ngapuna, Rotorua

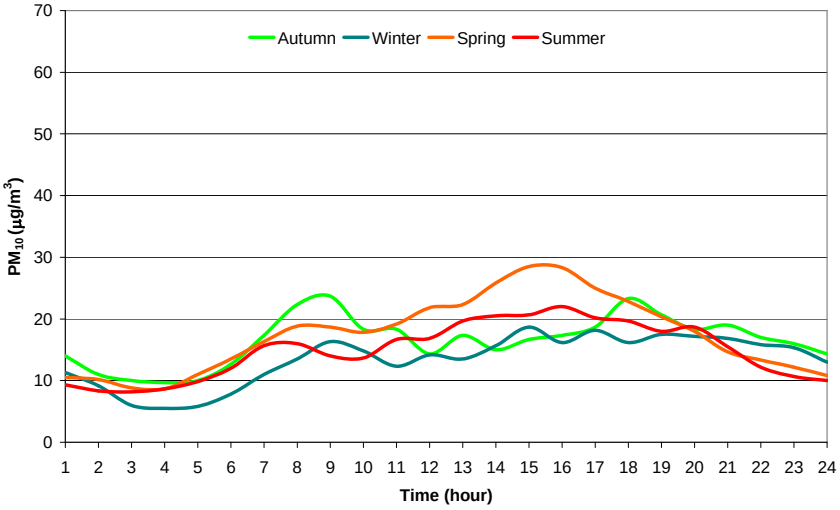
Environmental Performance Indicator PM_{10}.



Annual plot (2008 & 2009).



Seasonal diurnal plot.



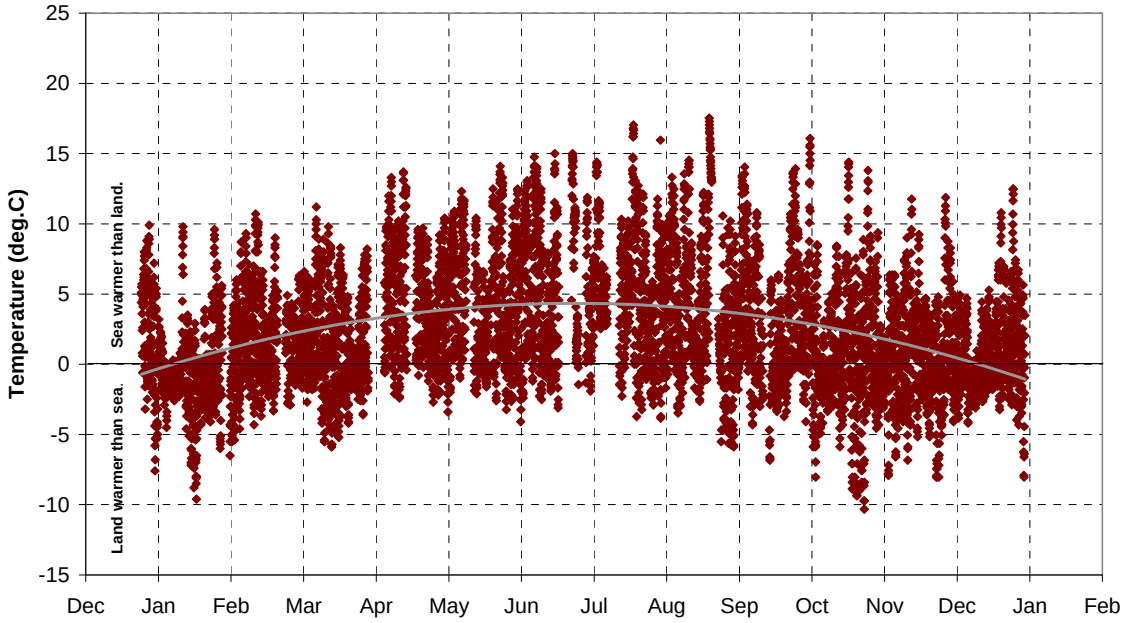
4.3.4 King Street, Whakatane

Location:

This site is bounded to the east by King Street which has an AADT of approximately 10,000[13]. Small volume feeder roads, James Street and Victoria Avenue to the south and north respectively have AADT's of 2,500 and 700. This site is also impacted by domestic heating and is located centrally in the Whakatane township to address this dominant source for many urban areas within New Zealand[14].

The open coastline is 1.5 km to the northeast at its closest point. The Whakatane urban area is located at the north eastern corner of the Rangitaiki Plains. The plains extend from the coastline inland for 14 km in a southerly direction to the Awakeri foothills. The topography is gentle sloping from south to north. Immediately to the east of the urban area is the greywacke escarpment rising to several hundred metres forming the eastern horst block of this horst – graben (plains) tectonic structure. This topographic/coastal setting results in interesting meteorological patterns as temperature variation (see graph of data from Environment Bay of Plenty wave buoy and land meteorological station) creates and drives localised air mass circulation and coastal fumigation situations.

Land / sea temperature differences - 2006.



PM_{10}:

The period of record at this monitoring site is continuing to grow, as initial monitoring in Whakatane was undertaken at Quay Street[15] for a period of eight years. The data from this more recent period shows that for more than 95% of the time the air quality in relation to PM_{10} concentration is acceptable or better. This is slightly worse than what was recorded at Quay Street but understandable due to the differing locations and impacting emission sources.

[13] Supplied by Whakatane District Council, February 2008.
[14] http://www.mfe.govt.nz/environmental-reporting/air/airsheds.html
[15] Iremonger , S. D., 2008, NERMN Air Monitoring 2007, Environment Bay of Plenty, Environmental Publication 2008/01, p74.

There was statistically insufficient data for a 2009 EPI column to be included within the plot.

The combined annual plot shows no exceedances of the standard, but also a rather scattered distribution of data points. A wintertime build up in concentrations is evident as is expected for this location. There are however other periods of time where elevated values are measured, further inspection of these periods show a probable mixture of some anthropogenic sources but wind information supports natural contributions from the nearby coastal environment (this pattern is also evident in a short period of monitoring undertaken in the Henderson Street area during May to October 2008[16]).

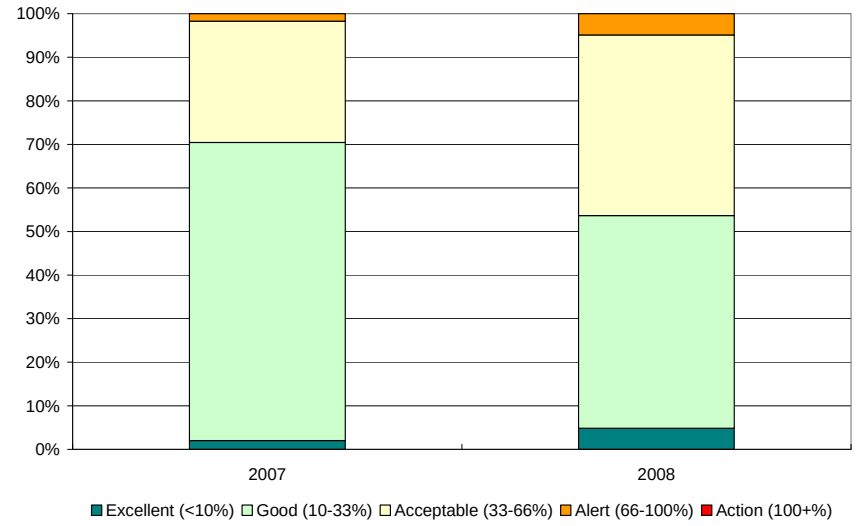
The seasonal diurnal plot shows the typical winter time profile, with increases in concentration in the evening and morning (8-10 am). The autumn trace has the same but a more subdued profile. Spring and summer plots show a stable profile with little change throughout the day although summer does show the effects of the sea breeze bringing material from the coastal environment and the intermediate land between the coastline and the sampler. Interestingly there are times when the drainage flows (referred to by local iwi as Te Hau Okiwa[17]) during the cooler months provide a "cleaner" air mass over the urban area.

[16] Iremonger, S.D., Whakatane West Air Quality monitoring report, Environment Bay of Plenty, Internal report, p19.

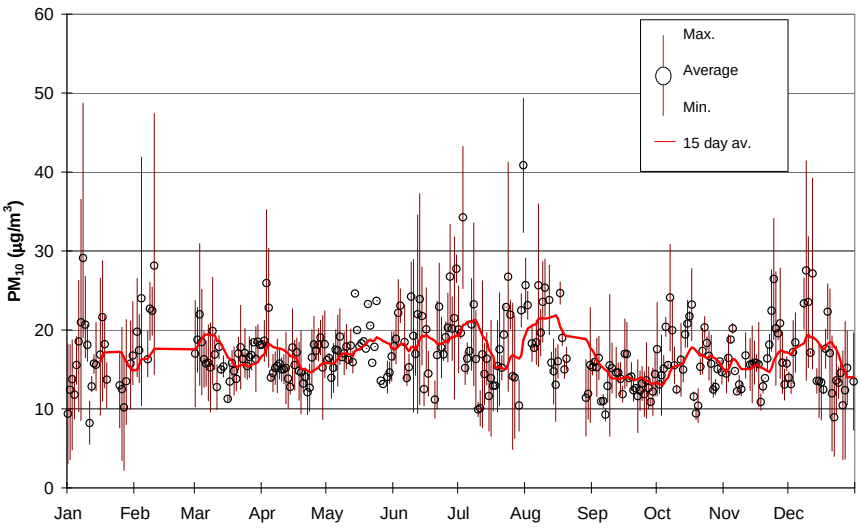
[17] Te Ao Hou, The New World, May 1957, No,18. *A Dog Barks in the Night.* Mereana. (http://teaohou.natlib.govt.nz/journals/teaohou/issue/Mao18TeA/c22.html)

King Street, Whakatane

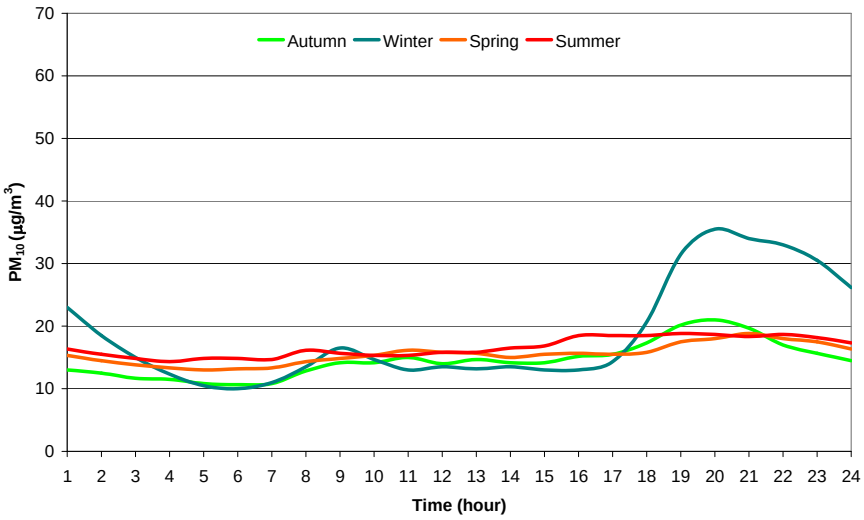
Environmental Performance Indicator PM_{10}



Annual plot (2007 to 2009).



Seasonal diurnal plot.



4.3.5 Totara Street, Mount Maunganui

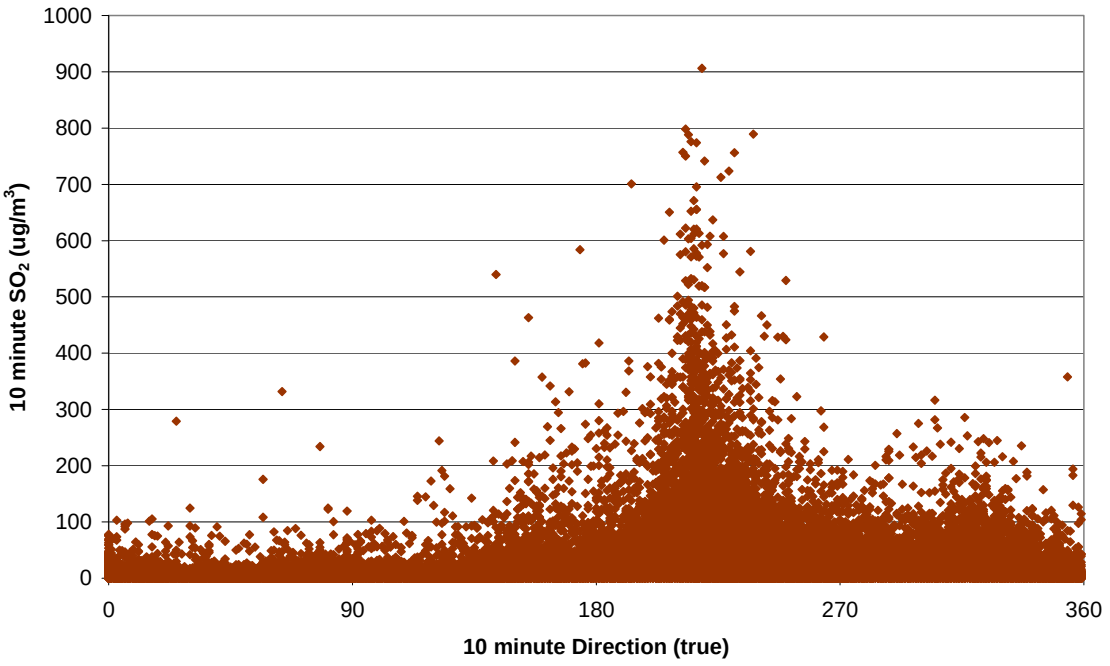
Location:

This site is bounded immediately to the west by Totara Street which has an AADT of approximately 10,000. Hewletts Road, ~300 m to the south has an AADT of ~30,000. These flows are predicted to increase as improvements to Hewletts Road are finalised and the second Mount Maunganui/Tauranga Harbour Bridge has now been commissioned. This site is impacted by a wide range of sources (natural, industrial and various forms of transport combustion). These sources surround the site for within a minimum of 500 m in all directions. The open coastline is 1.5 km to the northeast at its closest point and the harbour/land interface is located 500 m to the west and south of the monitoring site. This topographic setting results in complex meteorological patterns as temperature variation creates and drives localised airmass circulation.

SO_2:

For the majority of time the SO_2 values fall in the "Excellent" category. However during the summer and autumn months, exceedances of the 350μg/m^3 and 570μg/m^3 standard have been recorded. In 2006, 21 exceedances of the lower standard were recorded, with three occasions when the second standard was exceeded (with a maximum of 674 μg/m^3 being measured).

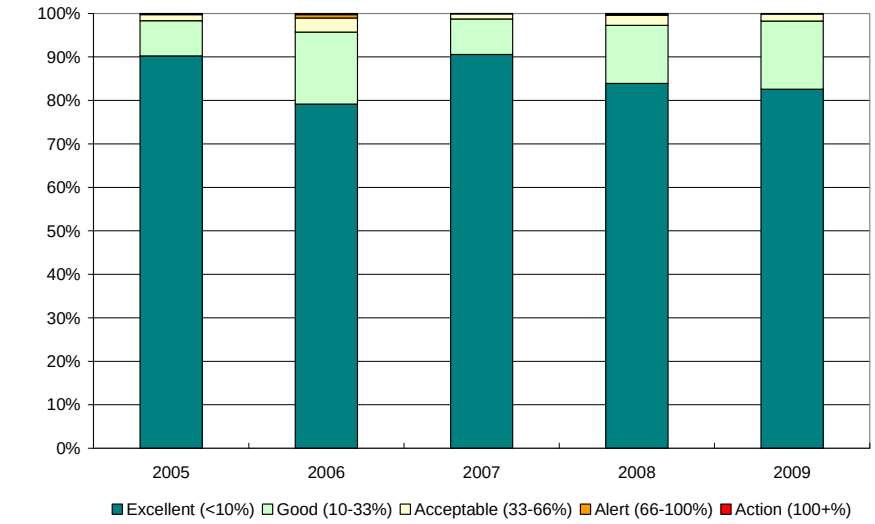
The seasonal increase is reflected well in the diurnal plots, with the autumn and summer time traces showing peaks and elevated levels. Analysis of the 10 minute SO_2 data and onsite meteorology shows a build up of higher concentrations in the southwest quadrant which is impacted by both industry and traffic sources. Values diminish in the arc from north to southeast. This concentration – wind direction pattern was also recorded in monitoring undertaken in 1994[18], 10 minute concentrations during this earlier monitoring were less than those recorded more recently.



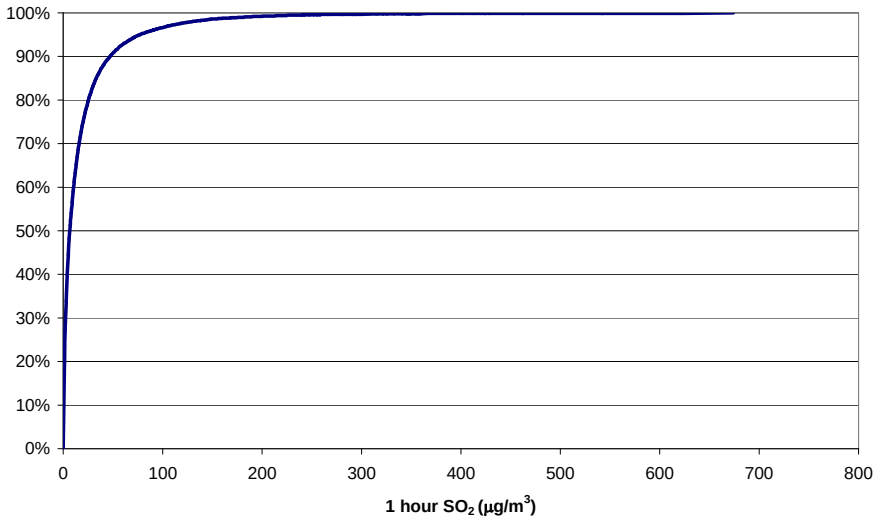
[18] Hally, V. M. et al, 1995, Ambient air monitoring in Mt Maunganui September – December 1994, Institute of Environmental Science and Research Limited, Auckland, New Zealand.

Totara Street, Mount Maunganui

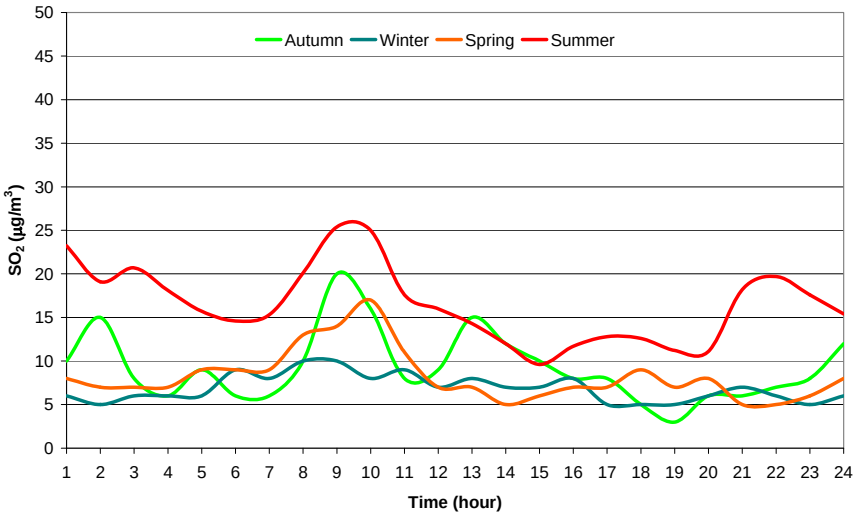
Environmental Performance Indicator SO_2



Distribution plot (2005 - 2009).



Seasonal diurnal plot.



4.3.6 Maru Street, Mount Maunganui

Location:

The site is located on the western side of Maru Street on property owned by Ballance Agri Nutrients Limited. The sampling inlet is situated 160 m from Maru Street (AADT ~1000) and 260 m north of Hewletts Road (AADT ~30,000). The site was set up to run in tandem with the Totara Street SO_2 instrument in order to monitor SO_2 levels from the two main industrial emitters of this contaminant. The site location was determined from modelling data presented as part of the consent renewal application for Ballance[19].

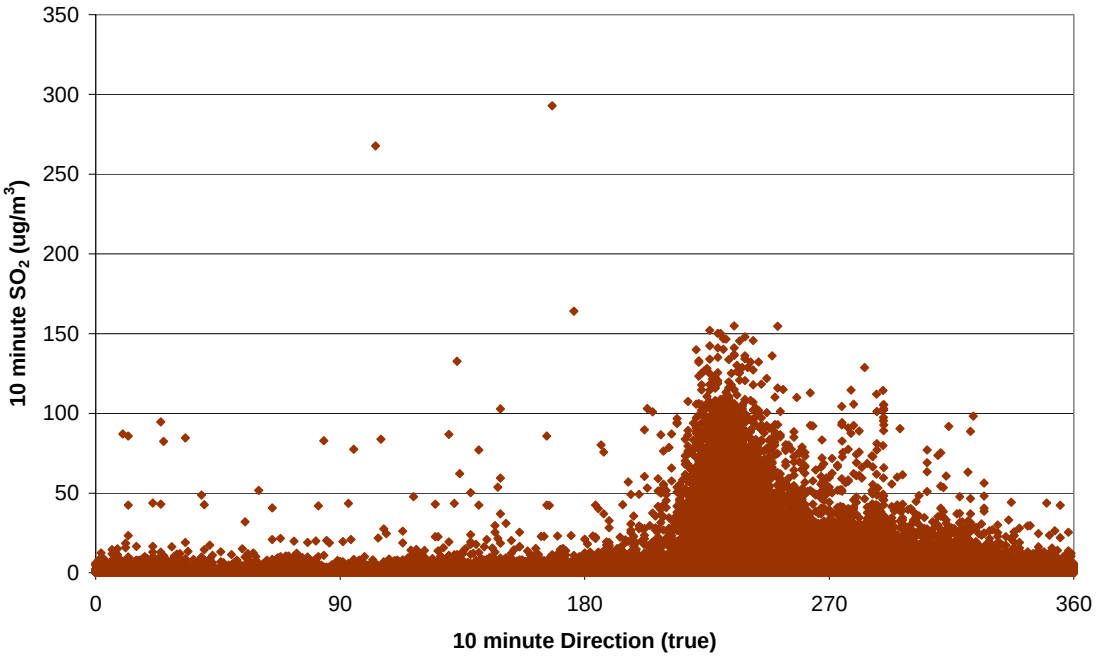
SO_2:

The period of record at this monitoring site is only short with the record beginning in July 2007. The performance indicator plots show that for over 95% of the time, hourly average values of this contaminant are Excellent (less than 10% of the standard). The maximum hourly value recorded is 268 $\mu g/m^3$.

Unlike the Totara Street diurnal plot the Maru plot is unremarkable. Summer shows the greatest daily variability as a result of the complex wind pattern resulting from the land/marine boundary climate interactions.

The comparison with the Totara Street 10 minute dataset shows (June 2007 to October 2008) shows a similar grouping of elevated SO_2 levels with a particular wind direction. A greater ground level impact from the industrial site (and the vehicular sources) that the Totara site was setup to monitor occurs. The impact from the industrial site upwind (south-westerly prevailing wind) of the Maru Street site does not appear to impact the ground level concentrations at the Maru Street monitoring site to the same extent.

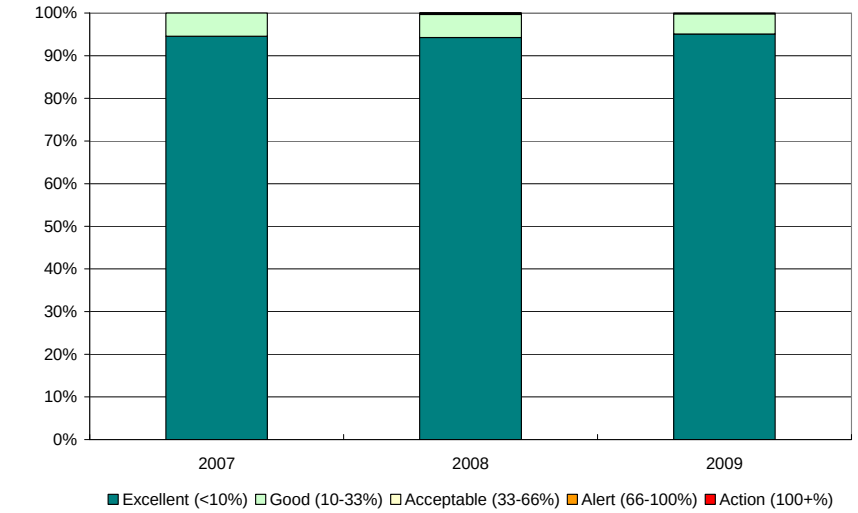
Like the Totara Street site analysis of the Maru Street 10 minute SO_2 data and Totara Street meteorology shows a build up of higher concentrations in the southwest quadrant which is impacted by predominant industry and due to distance a lesser extent traffic sources. Values diminish in the arc from north to southeast.



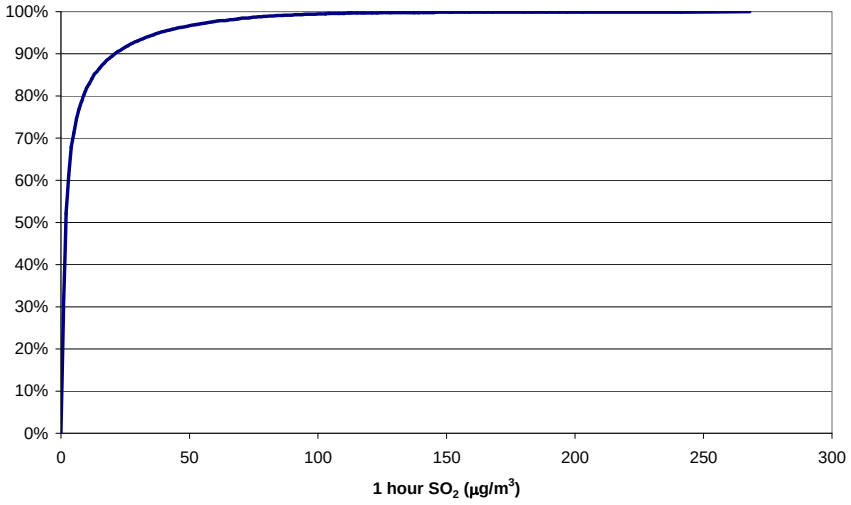
[19] Bay of Plenty Regional Council, Resource Consent 64800, issued June 2008, expires July 2028.

Maru Street, Mount Maunganui

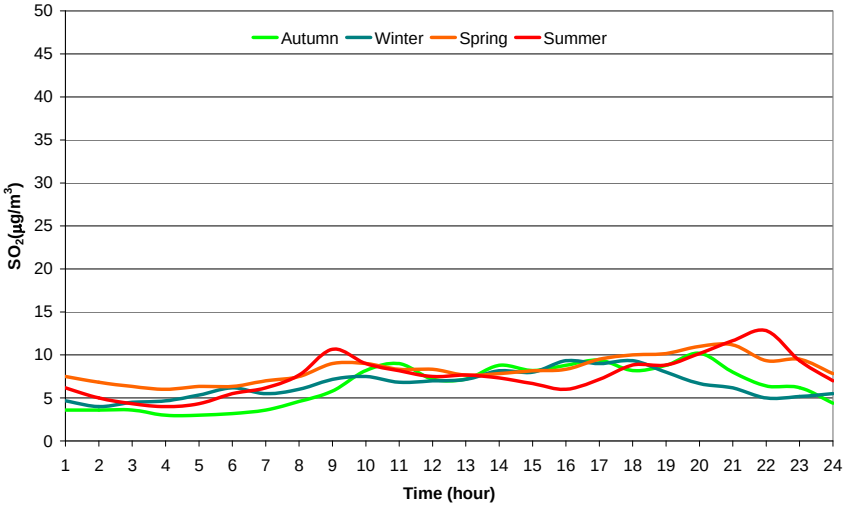
Environmental Performance Indicator SO_2



Distribution plot (2007 & 2009).



Seasonal diurnal plot.



4.3.7 Otumoetai Road, Tauranga

Location:

Like Pererika this site is impacted by two main anthropogenic sources; the Otumoetai Road roadway (AADT ~10,000) 20 m to the east and residential areas in all directions for at least 700 m. Immediately to the north is the Otumoetai Primary School, with associated playing fields. Census heating data shows a dominance of electricity followed equally by bottled gas and wood burners.

PM_{10}:

For the majority of time the PM_{10} values are measured in the 'Good' air quality category (>70% of the record). However during the winter months, air quality can reduce and fall into the 'Acceptable' category. During the nine years of monitoring air quality has never been within the 'Action' category. This seasonal increase is reflected in the diurnal plots, with winter time being the time of elevated concentrations.

The annual plot (summarising 11 years of record) shows little variation in average values throughout the year. Summer time values often equal or exceed winter time values which are markedly different from other urban monitoring sites within the region. Domestic heating patterns also differ and coupled with a strong meteorological and topography influence this annual pattern is not unexpected.

On a daily scale the winter time plot shows the dominating effect of domestic heating sources, with a noticeable increase in the morning on top of the traffic contribution and then an increase on summer time levels being recorded during the evening as emissions from wood burners impact the site. The diurnal plot also shows elevated levels for summer during the day which would be the result of the daily sea breeze transporting marine derived particles across the area.

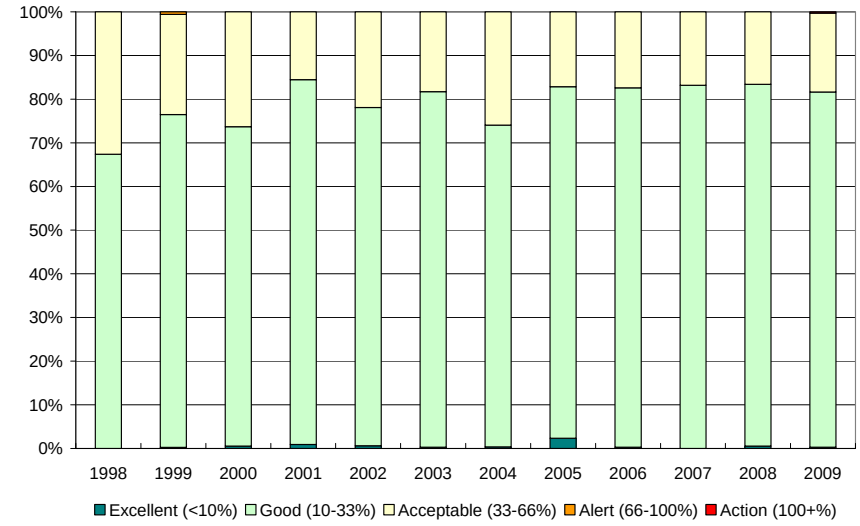
CO:

Carbon monoxide values recorded at this site exhibit the same trends as the PM_{10} record, with a pronounced increase visible during the winter months. The MfE standard is not exceeded at this site. Values are lower than at the other long-term residential monitoring site (Pererika), which is due to differences in local meteorological conditions and vehicle densities. The wind roses from Tauranga Airport show the prevailing wind for this area is from the southwest quarter (see Section 3) suggesting that CO emissions from vehicles may often get transported away from the sampling inlet.

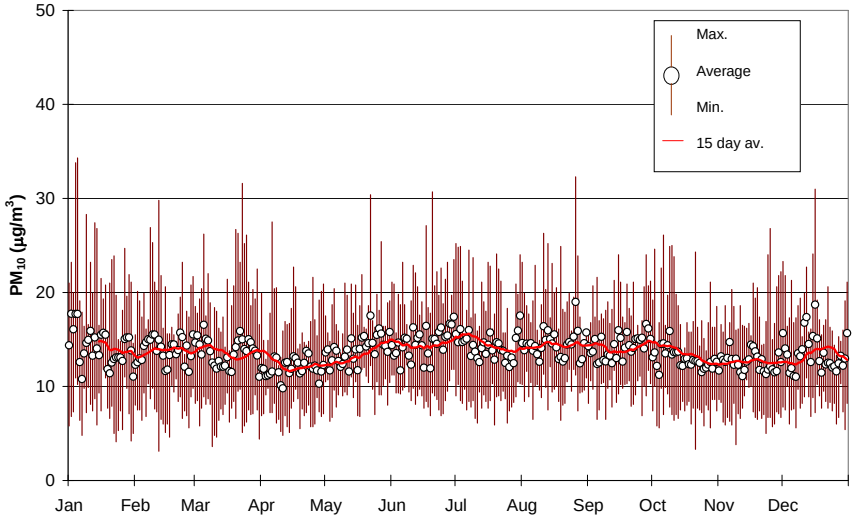
Levels are generally depressed during the day (probably the result of wind conditions causing increased mixing) with noticeable increases from 17:00 particularly in the autumn and winter months where domestic heating would be a significant producer of carbon monoxide.

Otumoetai Road, Tauranga

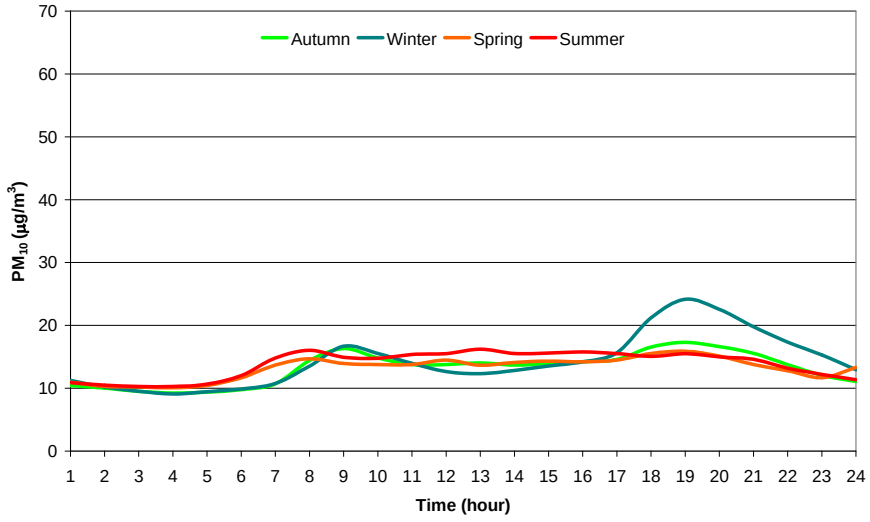
Environmental Performance Indicator PM_{10}



Annual plot (1998 - 2009).



Seasonal diurnal plot.



4.3.8 Pongakawa Bush Road, Pongakawa

Location:

The site is surrounded by pasture on a dairy farm and is termed 'background'. Levels at this site would be expected to be lower than a commercial or industrial site. The original instrument worked on a non-continuous principle, which required field staff to change filters on a nine day rotation. There were three sampling inlets at the site and the sample regime worked on a three day interval. This instrument has been superseded with a Sequential Partisol and monitoring is now on a two day interval coupled with monthly site visits and filter exchanges.

PM_{10}:

As expected, values recorded at this site predominantly fall in the "Excellent" and "Good" categories. With "Excellent" being met approximately 20% of the time.

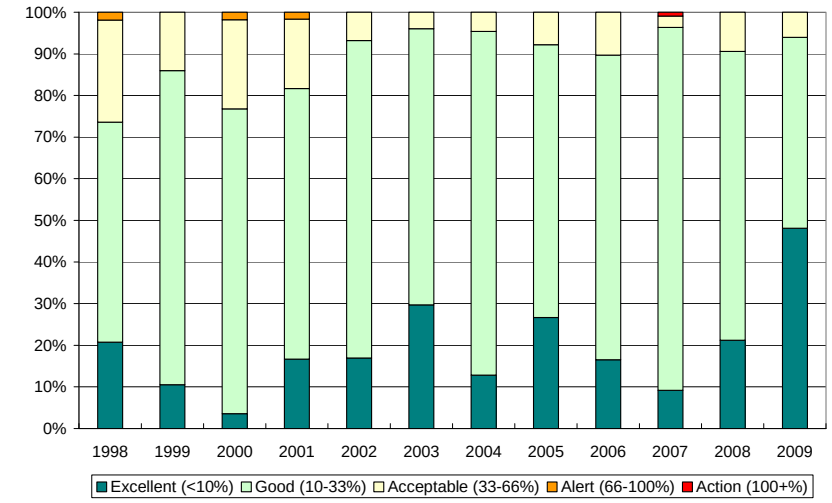
An annual trend is evident, as expected general dust production is negatively correlated with pasture growth and rainfall, thus resulting in increases in PM_{10} in the summer months. This pattern is shown by the combined daily average timeseries for the full period of record.

A full period average of 9.3$\mu g/m^3$ has been calculated and the 24-hour maximum to date is 51 $\mu g/m^3$ (October 2007) due to mechanical agricultural activities around the site.

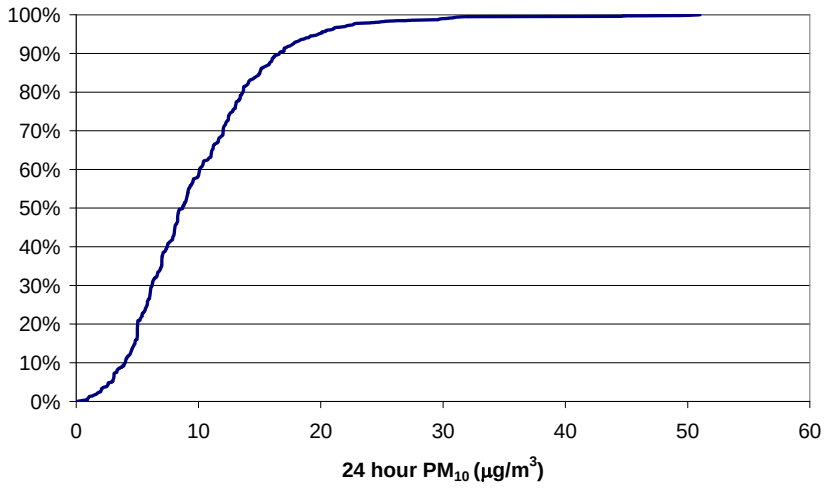
At both a regional and national level this is an important monitoring site, as quantification of the regional background component is vital for the planning and assessment of cost-effective emission reduction strategies for LAMA investigations, and for establishing baselines for resource consents relating to new discharges.

Pongakawa Bush Road, Pongakawa

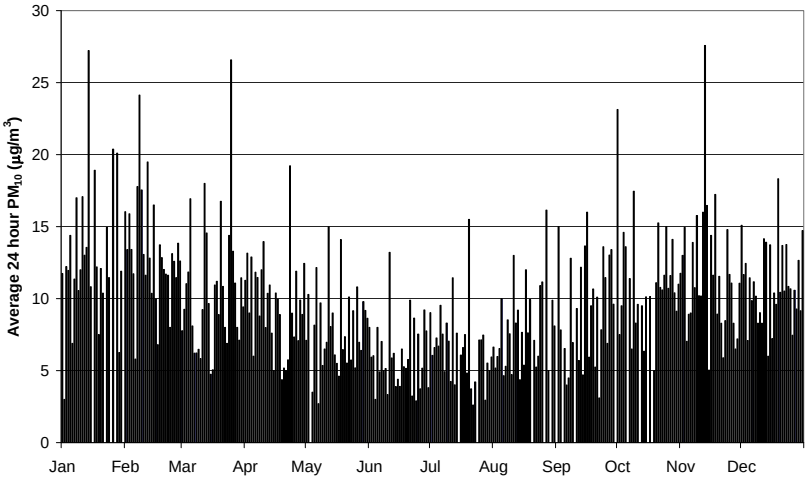
Environmental Performance Indicator PM_{10}.



Distribution plot.



Combined daily average timeseries.



4.3.9 Galway Street, Kawerau

Location:

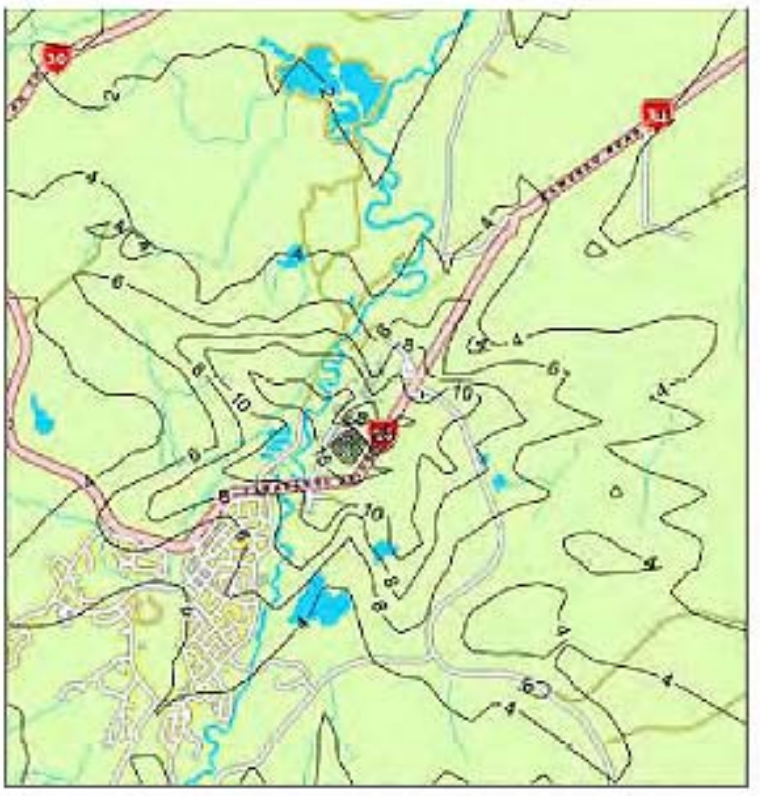
The site is located in the swimming pool enclosure at Kawerau North School in the northern sector of the Kawerau urban area. The Sequential Partisol instrument is located 10m back from Galway Street.

PM_{10}:

As expected, values recorded at this site predominantly fall in the "Excellent" and "Good" categories. With "Acceptable" or better having been recorded 98% of the time for PM_{10}.

Although a full annual record does not exist, a quasi-annual trend is evident as expected for a residential monitoring site with elevated concentrations being recorded in the winter months. A full period average of 14μg/m^3 has been calculated and the 24-hour maximum is 40μg/m^3 (July 2007).

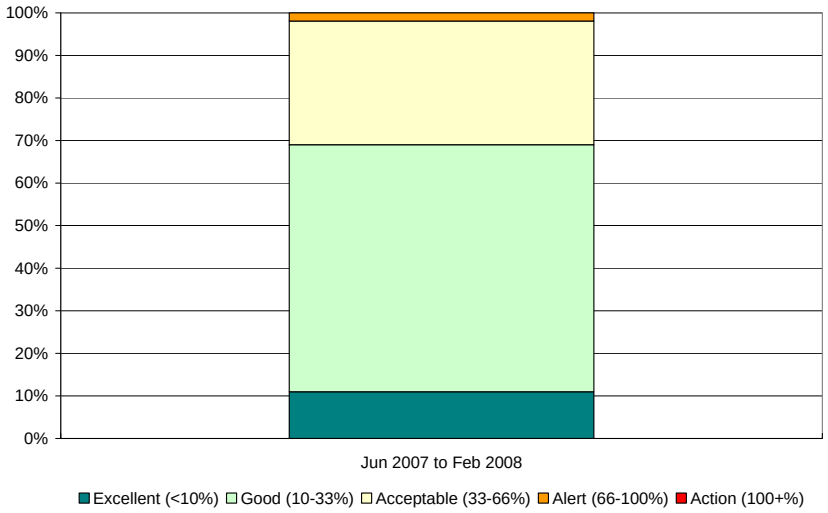
A recent air discharge technical report[20] produced for Carter Holt Harvey Pulp & Paper Limited showed modelled PM_{10} average emission rates (see below) from all mill stack sources to be in the range of 4 to 8μg/m^3 for Kawerau township. Maximum emission rates for these stack sources result in ground level concentrations of 15 to 25μg/m^3 based on the 2005 meteorological dataset.



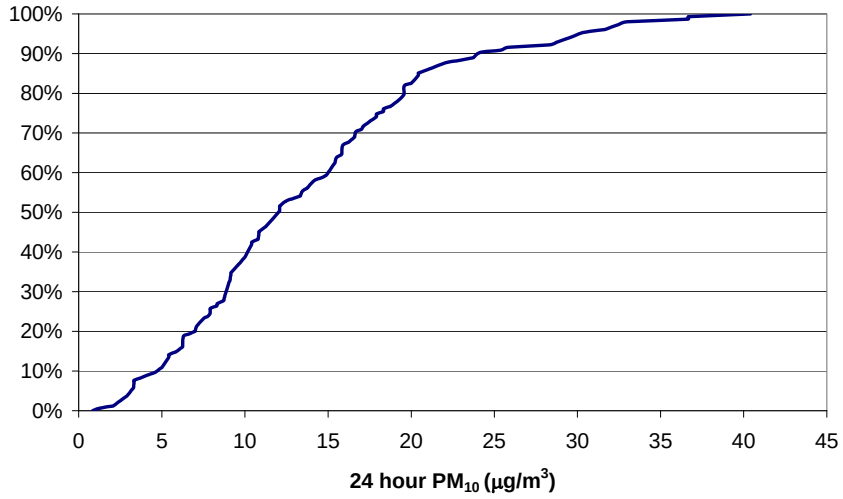
[20] Beca AMEC Ltd, 2009, Technical Air Discharges Report – Tasman Pulpmill, Prepared for Cater Holt Harvey Pulp & Paper Limited, p125.

Galway Street, Kawerau

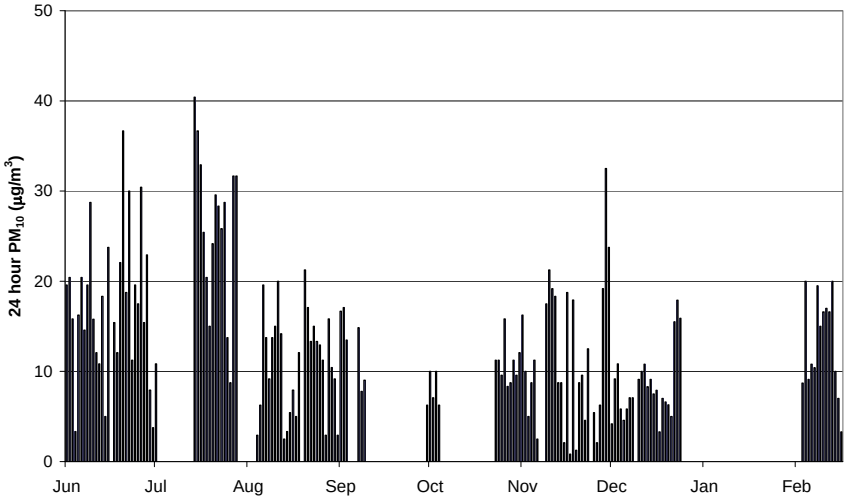
Environmental Performance Indicator PM_{10}



Distribution plot.



Daily timeseries (Jun 07 to Feb 08).



4.3.10 Other monitoring sites

Paraone Street, Ngongotaha.

Monitoring of PM_{10} using a Sequential Partisol has been recently undertaken at Paraone Street, Ngongotaha. The site is located in the rear of a residential property. The Mamaku Sawmill is located 150 to the southwest. The period of record extends from July 2008 to June 2009. The maximum result was 61$\mu g/m^3$ which was recorded on the 15/4/2009 the second highest was 43$\mu g/m^3$. Wind data for this daily period showed moderate wind from the north clockwise through to the southeast. The full period average was 16$\mu g/m^3$.

Due to the distributed nature of residential development (six small pockets of housing), the same air quality issues experienced within the Rotorua LAMA should not be experienced in Ngongotaha, therefore no inclusion of Ngongotaha in the LAMA is necessary at this point.

Te Ngae Road, Rotorua.

H_2S monitoring has been reinstated at this site in late 2008. This follows an unproductive period of SO_2 monitoring at Hull Road, Mount Maunganui. This site will be joined by several additional monitors measuring ambient H_2S which are part of the current H_2S exposure study[21].

Morland Fox Park, Tauranga.

Intermittent PM_{10} monitoring has been undertaken at this location due to instrumentation problems. The dataset to date consists of mainly non-wintertime data, however a partial wintertime record was captured in 2009. The 2009 annual average was 9.8$\mu g/m^3$, the maximum value for this period was 31$\mu g/m^3$. At the time of this report the site is operational.

[21] NIEHS-funded study "Effects of long-term, low-level hydrogen sulfide exposure" (5R01ES014038-02); Principal Investigator: Dr Michael N Bates.

Part 5: Monitoring recommendations

Environment Bay of Plenty is required to undertake monitoring activities as part of its statutory responsibilities under the Resource Management Act, 1991 and the NES-AQ, 2004. The Air Natural Environmental Regional Monitoring Network (Air NERMN) is based around a regional network of air quality monitoring sites designed for regional state-of-the environment monitoring, documentation and reporting. Natural environment monitoring determines the overall regional impact of activities on environment quality.

This monitoring recommendation (schedule) is for a period of five years, although annual NES-AQ reporting will provide updates and possible new directions for some of the monitoring. This schedule was first proposed in 1996 and reviewed and extended in 2003.

This section is designed to provide guidance to the councils Environmental Data Service section on the required monitoring. It combines the requirements of the NES-AQ and the existing NERMN air quality monitoring programme.

5.1 Proposed NES-AQ investigations

In addition to the Rotorua LAMA, five areas had been designated as requiring investigative PM_{10} monitoring[22], based on limited monitoring and inventory data at the time:

(a) Tauranga/Mount Maunganui

(b) Ngongotaha

(c) Kawerau

(d) Whakatane

(e) Te Puke

Since the proposal in 2005, monitoring has been undertaken at all of these sites, with the exception of Te Puke. Monitoring at this remaining site is planned to occur after the Sequential Partisol monitoring is completed at Ngongotaha.

5.2 Particulate matter (PM_{10})

Long term monitoring sites at Pererika and Otumoetai should continue to be operated, as the ten years of record already collected at these two sites provides the basis for valuable trend detection. Pererika is within the Rotorua LAMA and therefore important in the management of this airshed. Otumoetai is part of a larger area which is projected to experience accelerated growth in the decades to come.

The site at Pongakawa is important as an indicator of background concentrations within the region. This is an important contribution when determining strategies for LAMA's and assessing air discharge consent applications.

[22] Iremonger, S.D., 2005, Bay of Plenty Local Air Management Areas, Environmental Publication 2005/08, Environment Bay of Plenty, p29.

The Whakatane monitoring site (King Street) should be maintained as this is located in the middle of the third largest urban area in the region. It has a significant industry on the northwest boundary of the urban area and therefore ongoing monitoring of PM_{10} is important for detecting the contribution from a variety of sources.

The Morland Fox Park site (equipment supplied by MfE) is part of the NES-AQ monitoring, the suburb where the analyser is located has been identified as 'worst case' for domestic heating emissions for Tauranga City, this site will be key in determining whether a LAMA is needed in this area of the city.

The Edmund and Ngapuna sites should be continued as they are part of the current Rotorua LAMA monitoring programme. They will be key sites in monitoring the success of the Action Plan, and will provide direction if the strategies require modification.

The final site that requires PM_{10} monitoring is Te Puke; this will follow the deployment at Ngongotaha or occur earlier if other equipment becomes available. The period of monitoring at Te Puke should be the same as that for Ngongotaha - for a period of one year, with daily sampling for May to September inclusive and every second day for the remaining non-winter periods.

5.3 Carbon monoxide

CO monitoring can be down scaled due to the non-significance of recorded results to date. One site should be maintained at Otumoetai and one in the caravan which is currently at Ngapuna. This arrangement will allow us to keep track of the long term trends in the urban area with the greatest population and growth and also give the additional flexibility with the caravan to monitor at peak traffic sites if required or assess impacts of new roadway developments (e.g. Rotorua – Victoria Street expressway).

The Pererika CO monitoring can be discontinued.

5.4 Sulphur dioxide

Due to industry contributions and development in the port area, the monitoring at the Totara Street site should be continued. The extent of the monitoring within this industrial/commercial area should be continued for the time being. There is now a requirement for a specific industry within the area to also contribute to this monitoring programme as part of their resource consent. This development should be closely monitored and this section of the monitoring programme adjusted accordingly. The Hull Road instrument has been relocated back to Te Ngae Road, Rotorua to continue H_2S monitoring. The Maru Street instrument will join it shortly and will be located at the Pererika Street site initially.

5.5 Nitrogen dioxide

The levels of NO_x at Otumoetai indicate that no continuation of monitoring of this contaminant is required at this site. The analyser can now be moved to the Pererika Street site.

5.6 Hydrogen sulphide

The H_2S programme has been postponed due to the SO_2 monitoring requirements in Mount Maunganui. This focus is now changing and the H_2S programme has been reinitiated. This H_2S monitoring and historical work will be beneficial for the internationally funded H_2S long term exposure study (2007-2011)[21].

5.7 Volatile organic compounds (BTEX[23])

Six years have now passed since the reporting of the first passive sampling programme[24] for these contaminants. A new round of sampling has been initiated at the same Whakatane, Rotorua and Tauranga sites. This will provide a guide as to levels prior to the step down in the MfE guideline value this year (from 10 $\mu g/m^3$ (annual average) to 3.6 $\mu g/m^3$ to be achieved by 2010). Final analysis is yet to be completed, these new results will be reported separately in the near future.

5.8 Meteorology

Basic meteorological parameters (wind speed, direction, air temperature) should be recorded at each of the air quality monitoring sites. As a surrogate, nearby monitoring sites of other agencies (e.g. NIWA) can suffice if within several kilometres. This additional information provides more value to the primary dataset in determining causes of elevated concentrations and long term source contributions.

5.9 Modelling

The development of airshed and point source models has provided a valuable and powerful tool to complement ambient monitoring programmes. These models when validated against recorded data provide the ability to determine ground level concentrations of contaminants at a variety of locations rather than the single point associated with a monitoring site. This ability provides valuable information to staff for assessing NES-AQ compliance within the regional airshed and air discharge permit applications by industry.

This model application has worked successfully in the Rotorua LAMA science programme[3]. The model was also used to investigate emission reduction scenarios which provide guidance to the Action Plan initiatives.

Environment Bay of Plenty is now beginning to develop these models and the required operational skill set in house. The ability to run new scenarios quickly and reliably is dependant on sound emission and meteorological datasets, both of which are in the process of being developed internally.

[23] Benzene, Toluene, Ethylbenzene, Xylenes.
[24] Iremonger, S.D., 2002, NERMN Air monitoring, NOx, SOx and VOC's Passive Sampler Project 2000-2001, Environment Bay of Plenty, Environmental Report 2002/04, p30.

5.10 Data capture rates

Data capture rates continue to be monitored as an Environmental Data Services quality assurance tool and also as part of the performance target programme for the field technicians responsible for the operation of the equipment.

Generally high rates continue to be achieved although some sites have remained problematic (for a number of reasons).

The replacement of most of the first generation particulate monitoring equipment (1996 - 1998) has occurred and this should result in increased ease of operation and maintenance for the field staff.

Part 6: Contaminant summary

6.1 Particulate matter (PM_{10})

Particulate matter is an issue in Rotorua and steps have been undertaken to address this problem. Regional investigative monitoring (coupled with the long-term monitoring) should continue to be undertaken in order to identify any other 'hotspots' within the region and to comply with NES-AQ requirements. Adverse health effects from particulate exposure are now better understood and thus this contaminant should be the main focus of monitoring for the next five year period. Improvements in monitoring equipment should also be investigated to ensure high capture rates are maintained.

6.2 Carbon monoxide

Monitoring results for CO are well below the National Environmental Standard but a need for continuing vigilance around areas impacted by traffic and/or residential combustion remains, because of the potential for continuing increases in emissions due to increased population growth.

6.3 Sulphur dioxide

Due to the exceedances recorded to date in the Mount Maunganui industrial/port area monitoring should continue at the Totara Street site. This will improve the understanding of the ambient levels of this contaminant, and will add value to any further investigative work required in this area.

6.4 Nitrogen dioxide

Two years of monitoring next to Otumoetai Road in Tauranga has shown this contaminant is not of concern in this type of location. A proposed monitoring period of two years at Pererika Street, which has high traffic volumes, is now required to complete the monitoring of this contaminant.

6.5 Hydrogen sulphide

Concerns about possible health effects will only be resolved through long term health studies and these will continue to need supporting ambient data. To date the historical data shows no long-term trends which are discernable, this reflects the nature (episodic in many cases) of the geothermal source and the effects of meteorology within the Rotorua urban area.

Appendices

Appendix 1 – Monitoring methods used

Table A.1 Monitoring methods used.

Contaminant	Method
PM_{10}	TEOM (with co-location) and FDMS TEOM. United States Code of Federal Regulations, Title 40, Protection of Environment, Volume 2, Part 50, Appendix J, Reference method for the determination of particulate matter as PM_{10} in the atmosphere.
CO	Australian Standard AS3580.7.1:1992, Methods for sampling and analysis of ambient air, Determination of carbon monoxide, Direct-reading instrumental method.
SO_2	Australian Standard AS3580.4.1:2008, Methods for sampling and analysis of ambient air, Determination of sulphur dioxide, Direct-reading instrumental method.
NO_x	Australian Standard AS3580.5.1:1993, Methods for sampling and analysis of ambient air, Determination of oxides of nitrogen, Chemiluminescence method.
H_2S	Australian Standard AS3580.4.1:1990, Methods for sampling and analysis of ambient air, Determination of sulphur dioxide, Direct-reading instrumental method.
Site setup	Australian Standard AS/NZS 3580.1.1:2007 Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment
Compressed gas	Australian Standard AS/NZS 3580.2.2:2009 Methods for sampling and analysis of ambient air - Preparation of reference test atmospheres - Compressed gas method