ENVIRONMENT REPORT

AIR MONITORING REPORT 2011 -COMPLIANCE WITH THE NATIONAL ENVIRONMENT PROTECTION (AMBIENT AIR QUALITY) MEASURE

TASMANIAN AIR MONITORING REPORT 2011

COMPLIANCE WITH THE NATIONAL ENVIRONMENT PROTECTION MEASURE (AMBIENT AIR QUALITY) FOR 2011

BY TASMANIA

JULY 2012

ENVIRONMENT REPORT

AIR MONITORING REPORT 2011 -COMPLIANCE WITH THE NATIONAL ENVIRONMENT PROTECTION (AMBIENT AIR QUALITY) MEASURE

EPA DIVISION, TASMANIA,
JUNE 2012

Executive overview

This report presents the results of air quality monitoring in Tasmania and assesses them against the requirements of the Ambient Air Quality Environment Protection Measure (Air NEPM).[1] An electronic copy of this and previous year's reports, together with general air quality data tables, are available on the Tasmania EPA Divisions website.[2]

The Air NEPM establishes:

- Requirements for monitoring air quality,
- Air quality standards that are levels of specified pollutants against which air quality can be assessed,
- A goal that the air quality standard is met by 2008 to the extent specified in the NEPM. Recognising that certain events can impact on air quality, the NEPM specifies a maximum number of days on which it is permissible to exceed the standard.

Monitoring was performed in Hobart and Launceston, in accordance with the Tasmanian monitoring plan,[3] Air NEPM Technical Papers and the EPA Division's NATA accreditation. Data capture rates in excess of 75% were achieved at all stations except for $PM_{2.5}$ particulates in quarter 3 (Q3) at Launceston, due to equipment breakdown.

As an island with a cool climate and a relatively dispersed population, Tasmania experiences very low ambient levels of industrial and vehicle generated airborne pollutants, such as ozone (O_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO).

The major contribution to urban air pollution in Tasmania is smoke from domestic wood heaters and agricultural and forestry burning. This occurs during the autumn and winter with a contribution from bushfires in the summer months.

The overall particle pollution levels in Tasmania during 2011 were marginally lower than in 2010, with no exceedences of the PM_{10} standard in Hobart or Launceston.

The 24-hour advisory standard for particles (as $PM_{2.5}$) was exceeded on 6 days in Launceston during 2011. All these events occurred during cold relatively calm weather, with accumulated smoke from domestic heaters identified as the most likely cause. The annual reporting standard for $PM_{2.5}$ (8 µg/m^3) was met in both Hobart (6.2 µg/m^3) and Launceston (7.1 µg/m^3) for the first time since $PM_{2.5}$ measurements commenced in 2005.

CO monitoring was undertaken in Hobart CBD from 19 Feb 2011 to the end of the year. Neither instrument standards nor reporting met the Air NEPM goal for the reporting period. However, data was calibrated to NEPM standard. The eight-hour advisory reporting standard for CO was not exceeded during the reporting period.

[1] National Environment Protection Measure for Ambient Air Quality, National Environment Protection Council publication, available from www.ewphc.gov.au

[2] Air Monitoring Report 2009, Compliance with the National Environment Protection Measure (Ambient Air Quality) by Tasmania July 2010, available from www.environment.tas.gov.au

[3] National Environment Protection Measure For Ambient Air Quality, Monitoring Plan for Tasmania, May 2001, available from www.environment.tas.gov.au.

TASMANIAN AIR MONITORING REPORT 2011

COMPLIANCE WITH THE NATIONAL ENVIRONMENT PROTECTION MEASURE (AMBIENT AIR QUALITY) FOR 2011 BY TASMANIA – JULY 2012

Contents

Table of Contents

Section A – Air NEPM Monitoring Summary 2011.

Under Clause 18 of the National Environmental Protection (Ambient Air Quality) Measure (Air NEPM), jurisdictions are required to submit an annual report on their compliance with the measure in an approved form. Content and format requirements for the annual report are detailed in the Air NEPM Technical Paper No. 8 which is available at www.ephc.gov.au .

Tasmania's Air NEPM air monitoring plan was approved by the National Environment Protection Council Ministers in 2001. Three Tasmanian regions with sufficient population to warrant the establishment of NEPM monitoring stations are defined in the monitoring plan. The details of the regional topography, climate, air pollution potential and population exposures are listed in Appendix A.

- The Hobart and Launceston regions have permanent performance monitoring stations, as listed in Table 1. A location map is given in Figure 1.
- A peak CO monitoring station was installed in Macquarie Street within the Hobart CBD in December 2010 and commissioned in February 2011.
- A permanent performance monitoring station is currently being installed in Devonport.

Description of the exposed population

A qualitative description of the exposed population represented by each monitoring station is in the location category column in Tables 1 and 2. A more detailed description of the exposed populations is given in Appendix B of this report.

Table 1: Tasmanian NEPM performance measuring stations

Region Performance monitoring station	**Location category**	**Site type**					
		CO	NO_2	O_3	SO_2	$PM_{2.5}$	PM_{10}
Hobart							
New Town	Residential					G & T	G & T
Macquarie Street	CBD	Peak					
Launceston							
Ti Tree Bend	Light Industry					G & T	G & T
Devonport (Under construction)							
Devonport TAFE	Residential					G & T	G & T

G = Generally Representative Upper Bound **T** = Trend station

Table 2: Summary of station's siting compliance with AS 3580.1.1-2007

Region Station	Location category	Height above ground	Min. distance to support structure	Clear sky angle of 120°	Unrestricted airflow of 170°/360°	20m from trees	No nearby boilers or incinerators	Distance from roads or traffic
Hobart								
New Town	Residential	√	√	√	√	√	√	√
Macquarie St.	CBD	√	√	Urban canyon	Urban canyon	X	√	Roadside peak site
Launceston								
Ti Tree Bend	Light industry	√	√	√	√	√	√	√
Devonport								
Devonport TAFE	Residential	√	√	√	√	√	√	√

Figure 1: Existing and planned Air NEPM regions and gravimetric $PM_{2.5}$ and PM_{10} air monitoring stations in Tasmania

Implementation of the monitoring plan

The Hobart Performance and Trend monitoring station was moved approximately 2.5 km from the Prince of Wales Bay to New Town in May 2006. The background and rationale for this move are detailed in Appendix B.

The Launceston Performance and Trend monitoring station at Ti Tree Bend Waste Water plant was moved approximately 200 metres in December 2008 to avoid local dust contamination, as detailed in Appendix B.

As detailed in the 2010 report, the installation of a NEPM ambient air monitoring station in Devonport was delayed by difficulties in negotiating access to a suitable site. Following the successful resolution of these issues during 2011, a transportable station building for the Devonport air monitoring station was installed in the grounds of the Devonport TAFE (Polytechnic) college in June 2012, as detailed in Appendix B. Commissioning of the monitoring instruments is currently in progress, and the station is expected to be fully operational in August 2012.

Monitoring methods

NEPM compliance air monitoring in Tasmania is conducted in accordance with the relevant Australian standards shown in Table 3. Data not meeting the requirements of these standards and the EPA Division's quality assurance procedures are identified as invalid and not included in this report.

Particle concentrations in $\mu g/m^3$ have been corrected for the ambient air density and refer to a volume of air at 0°C (273.15°K) and a pressure of one standard atmosphere (101.325 kPa).

PM_{10} particle data measured by the Tapered Element Oscillating Microbalance (TEOM) included in this report incorporates an empirical ambient temperature adjustment as described in Appendix C. This adjustment is identical to the approved procedure described in NEPM Technical Paper 10,[4] except that low temperature cut-off for the application of the linear temperature correction has been reduced from 5°C to 0°C, to reflect the lower ambient temperatures experienced in Tasmania. A consequence of this adjustment is no TEOM measurement change on days with an average temperature at, or above 15°C, to a 60% increase in TEOM measurements at a daily average temperature of 0°C.

Table 3: Methods for monitoring NEPM pollutants in Tasmania

Pollutant		Standard	Title	Method used
Particles	PM_{10}	AS3580.9.8:2006	Ambient air – PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser	TEOM (tapered element oscillating microbalance)
Particles	PM_{10}	AS3580.9.9:2006	Ambient air – Determination of suspended particulate matter – PM_{10} low volume sampler – Gravimetric method	Low volume air sampler. Gravimetric reference method.
Particles	$PM_{2.5}$	AS3580.9.10:2006	Ambient air – Determination of suspended particulate matter – $PM_{2.5}$ low volume sampler – Gravimetric method	Low volume air sampler. Gravimetric reference method.
Carbon monoxide	CO	AS3580.7.1: 2011	Determination of Carbon Monoxide-Direct Reading Instrumental Method	Infra red absorption with gas filter correlation

NATA status

The Tasmanian ambient air monitoring programme holds NATA Accreditation (NATA Certificate No. 16646, issued 7/4/2009) for the determination of $PM_{2.5}$ and PM_{10} using the Andersen RAAS samplers according to the methods described in AS3580.9.9:2008 and 3580.9.10:2008. This accreditation was extended in 2011 to cover the operation of the alternative US-EPA compliant R & P Partisol Plus™ low volume samplers.

Following an external NATA audit of the PM_{10} TEOM methodology in August 2010, this accreditation has been extended to cover the continuous gravimetric determination of PM_{10} using the TEOM method according to AS3580.9.8:2008.

[4] National Environment Protection (Ambient Air Quality) Measure Technical Paper No. 10, Collection and Reporting of TEOM PM_{10} Data, available from www.ephc.gov.au

Screening for other pollutants

Monitoring for other listed Air NEPM pollutants is not performed at the Tasmanian NEPM stations of Launceston and Hobart because work carried out previously in Tasmania[3], and non-NEPM monitoring of SO_2 and NO_2 at George Town, have all indicated that the probable levels of Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2) and ozone (O_3) would be well below the corresponding NEPM standards.

Details of past screening studies conducted in Tasmania are presented in the Air NEPM Monitoring Plan for Tasmania[3], and are summarised in Table 4. Details of other non-NEPM monitoring activities are available in Appendix A.

Table 4: Screening Results for other Air NEPM pollutants

Pollutant (Air NEPM standard)	**Hobart**	**Launceston**
Ozone (0.1 ppm, 1 hour)	Sampled 1994-1995, Max. 1 hr average 0.03 ppm	Sampled 1992-1993, max 1-hr level was 0.04 ppm
Nitrogen Dioxide (0.12 ppm, 1hour); (0.03 ppm, 1-year)	No data available. No significant sources	CSIRO - Ti Tree Bend (2007 – 2008) Maximum 1-hr average 0.04 ppm, Average (11 months) 0.004 ppm,
Carbon Monoxide (9.0 ppm, 8 hours)	Prince of Wales Bay (2000-2004) Max. 8 hour average 2.3 ppm 95th percentile (8-hr) 0.4 ppm	CSIRO - Ti Tree Bend (2008) Max. 8 hour average 2.7 ppm Average (4 months) 1.0 ppm
Sulphur Dioxide (0.2 ppm, 1 hour); (0.08 ppm, 1 day); (0.02 ppm, 1 year)	Technology Park (2001 - 2003) Max. 1 hour average 0.136 ppm Max. daily average 0.025 ppm Annual average 0.002 ppm	George Town (2007 – 2011) Max. 1 hour average 0.018 ppm Max. daily average 0.007 ppm Annual average 0.001 ppm
Lead (0.50 µg/m^3)	Sampled 1989-1996 (intermittent) Annual average (1996) 0.2 µg/m^3	Sampled 1993-1998 (intermittent) Annual average (1996) 0.02 µg/m^3

$PM_{2.5}$ monitoring

In 2003, the NEPM was varied to include advisory reporting standards for $PM_{2.5}$ particles. Tasmania monitors daily $PM_{2.5}$ concentrations according to AS/NZS 3580.9.10. at both the Hobart and Launceston reference stations using Anderson Reference Ambient Air Samplers (RAAS) fitted with $PM_{2.5}$ very sharp cut cyclones (VSCC), Gravimetric $PM_{2.5}$ monitoring at Devonport will also be conducted according to AS/NZS 3580.9.10., but using US-EPA compliant R&P Partisol Plus™ low volume air samplers fitted with $PM_{2.5}$ very sharp cut cyclones (VSCC), TEOM monitors fitted with $PM_{2.5}$ VSCC were installed at the Hobart and Launceston NEPM stations in 2010 and have been collecting real-time gravimetric $PM_{2.5}$ data since 1/1/2011.

Section B. - Assessment of compliance with Standards and Goal

Air quality is assessed against the Air NEPM standards and goal as shown in Table 5.

Table 5: Air NEPM air quality standards and goal

Pollutant	**Averaging Period**	**Standard** (Note 1)	**2008 goal.** (Note 2) **Maximum allowable exceedences**
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen dioxide	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	None
Ozone	1 hour	0.10 ppm	1 day a year
	4 hours	0.08 ppm	1 day a year
Sulphur dioxide	1 hour	0.20 ppm	1 day a year
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	None
Particles as PM_{10}	1 day	50 $\mu g/m^3$	5 days a year
Lead	1 day	0.50 $\mu g/m^3$	None
Particles as $PM_{2.5}$	1 day	25 $\mu g/m^3$	Not applicable
	1 year	8 $\mu g/m^3$	Not applicable

Notes 1 Standards are concentrations, in parts per million (ppm), or micrograms per cubic metre ($\mu g/m^3$), against which air quality can be assessed.

2 The goal of the Air NEPM is to achieve the National Environment Protection Standards within 10 years of commencement (1998) as assessed in accordance with the monitoring protocol to the extent specified in Schedule 2 of the Air NEPM[1]. The extent is the maximum allowable number of exceedences for each standard (shown in column 4)

The number of allowable exceedences associated with the standards has been set to account for unusual meteorological conditions and, in the case of particles, for natural events such as bushfires and dust storms that cannot be controlled through normal air quality management strategies.

Air quality data from each monitoring site is assessed against these standards and the associated goal. No performance goal has been set for $PM_{2.5}$ at this time, but this will be reviewed when sufficient data becomes available.

The following tables summarise compliance with the standards and goal of the Air NEPM

Air quality is assessed as complying with the Air NEPM if:

- The number of exceedences does not exceed the relevant allowances set for the appropriate goal, and,
- Availability of valid data was at least 75% in each quarter of the year.

Regions also meet the standard if they do not require monitoring on the basis that screening shows pollutant levels are expected to be consistently below the relevant standards.

Compliance with the Air NEPM is assessed as 'not demonstrated' if insufficient data have been collected to demonstrate that the standards have or have not been met, or screening has not been completed.

Carbon monoxide

An air monitoring station to measure roadside CO levels in Macquarie Street in the Hobart CBD was commissioned in February 2011.

Table 6: 2011 summary statistics CO monitoring in Tasmania

Air NEPM Standard: 9 ppm (8 hour average)

Air NEPM 2008 Goal: Standard exceeded on no more than 1 day per year

Region Performance monitoring station	**Data availability (% of hours)**					**No. of exceedences (days)**	**Performance against the standard and goal**
	Q1	Q2	Q3	Q4	Annual		
Hobart Macquarie St.	43.6	96.5	79.4	86.9	76.6	0	Not demonstrated for full year

Data met the NEPM data fill requirement for Q2-Q4, but not Q1. All data was calibrated to NEPM standard, but not audited to NEPM standard. Thus no data met the NEPM standard or goal for 2011. No exceedences were recorded under the NEPM in 2011 for the recording period.

Nitrogen dioxide

Not monitored by NEPM performance stations in Tasmania. Screening and industry monitoring at George Town indicate ambient nitrogen dioxide levels are expected to be well below the relevant Air NEPM standard in both Hobart and Launceston.

Ozone

Not monitored in Tasmania. Screening studies indicate ambient ozone levels are expected to be well below the relevant Air NEPM standard in both Hobart and Launceston.
This is largely due to the relatively low concentration of motor vehicles, and climatic conditions generally unfavourable to the formation of petrochemical smog.

Sulphur dioxide

Not monitored by NEPM performance stations in Tasmania. Screening and industry monitoring at George Town and Hobart indicate ambient sulphur dioxide levels are expected to be well below the relevant Air NEPM standard in both Hobart and Launceston.

Particles as PM_{10}

Table 7 provides summary information demonstrating compliance with the Air NEPM goal for Tasmania for PM_{10} in 2011.

Table 7: Compliance summary for PM_{10} in Tasmania for the 2011 calendar year
Air NEPM Standard: 50 µg/m^3 (24 hour average)
Air NEPM 2008 Goal: Standard exceeded on no more than 5 days per year

Region/Performance Monitoring Station	**Data Availability Rates (% of days with 75% or more hourly samples per 24 hours for TEOMs)**					**No. of Exceedences**	**Performance against Standard and Goal**
Hobart: New Town	***Q1***	***Q2***	***Q3***	***Q4***	***Annual***	***Days***	
PM_{10} (All instruments)	99	100	100	100	100	0	
- LVAS (every day)	99	97	95	97	97	0	***MET***
- TEOM [1,2]	98	96	92	100	96	0	
Launceston: Ti Tree bend	***Q1***	***Q2***	***Q3***	***Q4***	***Annual***	***Days***	
PM_{10} (All instruments)	92	99	100	100	98	0	
- LVAS (every day)	59	97	99	97	88	0	***MET***
- TEOM [1, 2]	90	91	78	99	90	0	
Devonport:	Currently being installed and expected to be operational in third quarter of 2012.						***Not demonstrated***

Notes **1.** Temperature adjusted using local model according to Technical Guidance Paper 104

Adjusted PM_{10} = Measured PM_{10} x Temperature Correction Factor [TCF]

Where TCF = 1.00 for 24 hr average temperature $[T_{24}] \geq 15°C$

= $1.00 + (15 - T_{24}) / 25$ $0°C < T_{24} < 15°C$

= 1.60 When $T_{24} \leq 0°C$

2. Day-averaged TEOM data are used only when LVAS PM_{10} data are not available.

Particles as $PM_{2.5}$

The Air NEPM was varied in 2003 to include advisory reporting standards for particles as $PM_{2.5}$. There is no time frame for compliance, but monitoring by the reference method and other acceptable methods is required to be reported.

Table 8 summarises Tasmania's monitoring of $PM_{2.5}$ by the reference method, which is the only approved method to be used for comparisons with the advisory reporting standards. The goal is to gather sufficient data nationally to facilitate a review of the reporting standards as part of the review of the NEPM that commenced in 2005.

Table 8: Compliance summary for $PM_{2.5}$ in Tasmania for the 2011 calendar year

Air NEPM advisory reporting standard: 25 µg/m^3 (24 hour average)
8 µg/m^3 (annual average)

Region/Performance Monitoring Station	**Data Availability Rates**					**Number of exceedences**	**Annual mean**
Hobart: New Town	***Q1***	***Q2***	***Q3***	***Q4***	***Annual***	***Days***	
LVAS (every day)	87	96	99	98	95	0	6.2 µg/m^3
Launceston: Ti Tree bend	***Q1***	***Q2***	***Q3***	***Q4***	***Annual***	***Days***	
LVAS (every day)	53	98	100	96	87	6	7.5 µg/m^3
Devonport	Scheduled to begin operation in Q3 of 2012					N/A	

All 6 exceedence events observed in Launceston occurred on cold days with very light winds and were attributed to accumulated smoke from wood heaters, as detailed in Section C.

Lead

With the phasing out of leaded petrol, the concentrations of airborne lead measured in Hobart and Launceston fell well below the Air NEPM standard, and the monitoring of airborne lead was discontinued in 1998.

SECTION C – ANALYSIS OF AIR QUALITY MONITORING

The annual summary statistics for Tasmania are presented in Tables 9 to 13.

The Air NEPM states that short term standards should not be exceeded on more than one day each year for carbon monoxide, nitrogen dioxide, ozone and sulphur dioxide, or on more than five days per year for PM_{10}.

All occasions when a standard was exceeded are listed in the following tables, together with the circumstances leading to the exceedence. Concentrations exceeding the standard are highlighted in bold.

Tables of monitoring statistics presented in this section have been prepared according to Air NEPM guidelines.

Carbon monoxide

The 2011 summary statistics for carbon monoxide measurements in Tasmania are given in Table 9.

Table 9: 2011 summary statistics for daily peak 8 hour carbon monoxide in Tasmania

Air NEPM Standard: 9 ppm (8 hour average)
Air NEPM Goal: Standard exceeded on no more one day per year

Region	No. of valid days	Highest 8 hr CO (ppm)		2nd highest 8 hour CO (ppm)	
Hobart Macquarie street	277	01/06/2011 21:00	2.16	01/06/2011 20:00	2.15

Roadside CO is routinely monitored in Macquarie Street in the Hobart CBD, and calibrated to Level 1 standard under the NEPM. Data is to trace level and peak hourly CO showed sensitivity to both morning and afternoon traffic, with sensitivity highest in autumn and early winter when wind speed is low, and lowest in late winter, spring and summer when wind speed is relatively high.

Nitrogen dioxide

Not monitored at the NEPM reference stations in Hobart and Launceston.

Ozone

Not monitored in Tasmania

Sulphur dioxide

Not monitored at the NEPM reference stations in Hobart and Launceston.

Particles as PM_{10}

PM_{10} was monitored each day at the Hobart and Launceston stations by both LV air samplers and TEOM. The reported PM_{10} concentrations are preferentially from the LVAS reference method. On days when these data were not available, the 24-hour average PM_{10} has been estimated from the temperature adjusted PM_{10} TEOM measurements in conjunction withthe Tasmanian empirical correction factor derived according to the methods presented in Technical Guidance Paper 10.4

The 2011 summary statistics for Tasmania for PM_{10} are given in Table 10.

Table 10: 2011 summary statistics for 24-hour PM_{10} in Tasmania

Air NEPM Standard: 50 µg/m^3 (24 hour average)

Air NEPM 2008 Goal: Standard exceeded on no more than 5 days per year

Region Performance monitoring station	No. of valid days	Highest concentration		6th highest concentration	
		µg/m^3	Date	µg/m^3	Date
Hobart New Town	364	40.5	22/07/2011	28.4	21/07/2011
Launceston Ti Tree Bend	357	39.7	30/06/2011	33.8	01/07/2011

There were no recorded exceedences of the 50 µg/m^3 PM_{10} standard at Launceston or Hobart in 2011. This can be compared with 1 exceedence in Hobart in 2010, none in 2009, 1 in 2008 (Launceston), 5 in 2007 (all in Launceston) and 6 in 2006 (also all in Launceston).

Table 11: PM_{10} exceedences in 2010 for Tasmania

Air NEPM Standard: 50 µg/m^3 (24 hour average)

Air NEPM 2008 Goal: Standard exceeded on no more than 5 days per year

Region	**Hobart**	**Launceston**	**Devonport**	
Station	New Town	Ti Tree Bend	Devonport TAFE	**Inferred cause**
			Under construction	No PM_{10} exceedences observed

Particles as $PM_{2.5}$

$PM_{2.5}$ was monitored each day at the Hobart and Launceston stations by LV air samplers. The 2011 summary statistics for Tasmania for $PM_{2.5}$ are given in Table 12.

Table 12: 2011 summary statistics for 24-hour $PM_{2.5}$ in Tasmania

Air NEPM advisory reporting standard: 25 µg/m^3 (24 hour average)

Region & Station	No. of valid days	Highest concentration		6th highest concentration	
		µg/m^3	Date	µg/m^3	Date
Hobart, New Town	346	24.9	1/6/2011	20.2	24/7/2011
Launceston, Ti Tree Bend	317	**30.4**	11/6/2011	**25.6**	1/7/2011

No exceedences of the 24-hour $PM_{2.5}$ reporting standard were observed in Hobart during 2011, but the standard was exceeded on 6 days in Launceston, as listed in Tables 13 and 14.

Table 13: Exceedences of $PM_{2.5}$ 24-Hour Advisory Reporting Standard in 2011 at New Town, Hobart, with inferred causes (in descending order of concentration).

Air NEPM advisory reporting standard: 25 µg/m^3 (24 hour average)

Date	**$PM_{2.5}$** (µg/m^3)	**PM_{10}** (µg/m^3)	**Mean Temp.**	**Inferred cause**
				No exceedences observed

Table 14: Exceedences of $PM_{2.5}$ 24-Hour Reporting Standard in 2011, at Ti Tree Bend, Launceston, with inferred causes (in descending order of concentration).

Air NEPM advisory reporting standard: 25 µg/m^3 (24 hour average)

Date	PM2.5 (µg/m^3)	PM10 (µg/m^3)	Mean Temp	Inferred cause
6/11/2011	**30.4**	35.4	7.5 °C	Urban wood smoke
14/7/2011	**28.8**	37.0	3.4°C	Urban wood smoke
15/6/2011	**27.5**	34.6	4.1 °C	Urban wood smoke
27/5/2011	**27.2**	36.2	6.8 °C	Urban wood smoke
15/7/2011	**26.0**	32.8	2.8 °C	Urban wood smoke
1/7/2011	**25.6**	33.8	6.2 C	Urban wood smoke

Summary of progress towards achieving the Air NEPM goal in 2011

Compliance in 2011

Sufficient data was captured at both the New Town and Ti Tree Bend monitoring stations during 2011 to demonstrate compliance of the air quality in Hobart and Launceston with the Air NEPM standards and goal for PM_{10}. The highest 24-hour PM_{10} concentration measured at New Town in 2011 was 40.5 µg/m^3, which did not exceed the Air NEPM PM_{10} 24-hour standard of 50 µg/m^3. The 24-hour advisory $PM_{2.5}$ reporting standard of 25 µg/m^3 was not exceeded at New Town during 2011, with a maximum of 24.9 µg/m^3 measured on 1/6/2011, and 6 days exceeding 20 µg/m^3. The 2011 annual average $PM_{2.5}$ concentration for Hobart was 6.2 µg/m^3 which complied with the Air NEPM annual $PM_{2.5}$ advisory reporting standard of 8 µg/m^3.

The daily PM_{10} concentration measured at Ti Tree Bend in 2011 did not exceed the Air NEPM PM_{10} 24-hour standard of 50 µg/m^3, with a maximum value of 40.0 µg/m^3. While this was comparable with the maximum PM_{10} level measured in Hobart, Launceston experienced higher levels of winter smoke pollution, with the $PM_{2.5}$ concentration at Ti Tree Bend exceeding the 24-hour advisory reporting standard of 25 µg/m^3 on 6 days in 2011. These were all relatively calm winter days, where a combination of high wood heater use and light winds prevented effective smoke dispersion in the local airshed. The 2011 annual average $PM_{2.5}$ concentration of 7.5 µg/m^3 complied with the Air NEPM annual reporting standard for $PM_{2.5}$ of 8 µg/m^3.

Trends in compliance

Hobart

PM_{10} data measured at the Prince of Wales Bay station (July 2000 - July 2006) and New Town (May 2006 to present), have demonstrated that Hobart's air quality has complied with NEPM PM_{10} standard and goal since 2001 (see Tables 13 and 14, section D following).

Launceston

The ambient air quality in Launceston met the Air NEPM PM_{10} standard in 2011. This was the third successive year with no observed exceedences of the 50 µg/m^3 24-hour PM_{10} limit at the Ti Tree Bend air monitoring station, and the fifth successive year that the air quality in Launceston has met the Air NEPM goal for PM_{10} (see Tables 16 and 18, in section D following).

D. TRENDS AND POLLUTION DISTRIBUTIONS

Results of further analysis are presented in this section. The following tables present:

- Percentiles of 2011 daily peak concentrations are presented for each station and standard.
- Daily values are only reported for days with more than 75% of hourly data
- Exceedences are shown in bold type
- Data for stations with less than 75% annual data are shown in italics
- Data for years with less than 25% valid data (91 days) have not been reported.

Carbon monoxide

Table 15: 2011 percentiles for daily peak 8 hour carbon monoxide concentrations in Tasmania

Air NEPM standard: 9 ppm (8 hour average)

Air NEPM goal: Standard not exceeded on more than 1 day per year

Region and Performance Monitoring Station	Data Availability (% of days)	Max. ppm	Percentiles (ppm)						
			99th	98th	95th	90th	75th	50th	25th
Hobart Macquarie street	76.1	2.16	1.45	1.26	1.03	0.85	0.61	0.43	0.30

Nitrogen dioxide

No data collected at NEPM stations in Tasmania.

Ozone

Not measured in Tasmania

Sulphur dioxide

No data collected at NEPM stations in Tasmania.

Particles as PM_{10}

Table 16 provides summary statistics for the PM_{10} monitoring conducted in Hobart and Launceston for 2011. Historical summaries are also provided for Hobart in Table 17 and Launceston in Table 18.

Table 16: 2011 Summary Statistics for PM_{10}

Air NEPM standard: 50 µg/m^3 (24 hour average)

Air NEPM goal: Standard not exceeded more than 5 days per year

Region and Performance Monitoring Station	Data Availability (% of days)	Max. µg/m^3	Percentiles (µg/m^3)						
			99th	98th	95th	90th	75th	50th	25th
Hobart New Town	99.7	40.5	30.1	28.1	23.7	19.1	15.0	10.5	7.5
Launceston Ti Tree Bend	97.8	39.7	35.4	33.4	27.1	22.0	15.6	11.3	8.6

Exceedences shown in **bold**.

Table 17: Percentiles of 24-hour PM_{10} at New Town, Hobart (2006 – 2011)

Air NEPM Standard: 50 µg/m^3 (24 hour average)

Air NEPM 2008 goal: Standard exceeded on no more than 5 days per year

Year	Data Availability (% of days)	No. of exceedences (days)	Max. µg/m^3	Percentiles (µg/m^3)						
				99th	98th	95th	90th	75th	50th	25th
2006	*69.3*	*0*	*46.7*	*39.2*	*36.3*	*31.9*	*27.8*	*20.5*	*13.9*	*9.0*
2007	99.7	0	43.8	39.3	36.1	30.3	25.9	18.5	13.7	9.5
2008	100	0	48.7	38.7	37.1	29.6	25.3	18.7	12.9	8.6
2009	99.5	0	43.2	36.1	33.4	26.4	23.3	17.3	11.4	8.5
2010	99.2	1	**50.5**	30.6	29.3	25.5	22.3	17.2	12.0	7.9
2011	99.7	0	40.5	30.1	28.1	23.7	19.1	15.0	10.5	7.5

Years with data availability less than 75% are shown in *italics*. Exceedences are shown in **bold**

Table 18: Percentiles of 24-hour PM_{10} at Ti Tree Bend, Launceston (1997 – 2011)

Air NEPM Standard: 50 µg/m^3 (24 hour average)

Air NEPM 2008 goal: Standard exceeded on no more than 5 days per year

Year	Data Availability (% of days)	No. of exceedences (days)	Max. µg/m^3	Percentiles (µg/m^3)						
				99th	98th	95th	90th	75th	50th	25th
1997	*46.8*	***50***	***122.8***	***110.4***	***109.7***	***83.5***	***73.9***	***54.0***	*23.5*	*12.0*
1998	*51.0*	***47***	***125.0***	***124.4***	***112.0***	***88.0***	***74.8***	***51.2***	*24.1*	*11.6*
1999	*51.8*	***43***	***94.4***	***86.8***	***83.2***	***79.0***	***66.6***	*48.5*	*24.9*	*11.7*
2000	*53.0*	***38***	***110.4***	***89.2***	***85.6***	***74.8***	***71.5***	*42.3*	*23.6*	*10.3*
2001	*65.5*	***27***	***81.2***	***78.4***	***71.7***	***57.0***	***51.6***	*34.9*	*15.5*	*7.4*
2002	91.0	**13**	**76.4**	**70.6**	**59.4**	47.4	39.0	24.3	13.6	7.4
2003	85.5	**26**	**91.5**	**74.3**	**70.7**	**56.0**	43.4	26.5	15	8.3
2004	92.3	**10**	**86.1**	**67.6**	**54.0**	44.3	37.5	21.8	12.4	7.4
2005	99.2	**13**	**79.6**	**70.2**	**62.3**	47.6	39.6	23.4	13.9	9.5
2006	97.3	5	**86.3**	**53.5**	47.0	40.0	35.4	23.7	15.3	10.9
2007	96.4	5	**76.3**	**56.4**	**51.9**	40.0	31.1	21.6	15.0	11.1
2008	97.5	1	**75.7**	47.7	42.4	39.0	30.5	22.4	15.0	10.0
2009	100	0	44.1	42.3	38.1	29.8	22.1	16.4	12.2	8.4
2010	100	0	49.5	37.8	36.8	31.5	26.6	19.8	13.2	9.2
2011	97.8	0	39.7	35.4	33.4	27.1	22.0	15.6	11.3	8.6

Years with data availability less than 75% are shown in italics. Exceedences are shown in bold

Particles as $PM_{2.5}$

Table 19 provides summary statistics for the $PM_{2.5}$ monitoring conducted at Hobart and Launceston for 2011. Historical summaries are also provided for Hobart in Table 20 and Launceston in Table 21.

Table 19: 2011 Summary Statistics for $PM_{2.5}$

Air NEPM Reporting Standard: 25 µg/m^3 (24 hour average)
8 µg/m^3 (annual average)

Region and Performance Monitoring Station	Data Availability (% of days)	Max. µg/m^3	Percentiles (µg/m^3)						
			99th	98th	95th	90th	75th	50th	25th
Hobart									
New Town	94.8	24.9	20.9	20.0	14.8	12.5	7.4	4.9	3.4
Launceston									
Ti Tree Bend	86.8	**30.4**	**27.5**	**25.6**	20.5	16.2	9.4	5.4	3.8

Exceedences shown in **bold**.

Table 20: Percentiles of 24-hour $PM_{2.5}$ at New Town, Hobart (2006 – 2011)

Air NEPM Reporting Standard: 25 µg/m^3 (24 hour average)
8 µg/m^3 (annual average)

Year	Data Availability (% of days)	No. of exceedences (days)	Max. µg/m^3	Percentiles (µg/m^3)						
				99th	98th	95th	90th	75th	50th	25th
2006	*54.8*	*2*	***29.4***	***27.6***	*23.0*	*21.4*	*16.0*	*9.6*	*4.8*	*3.1*
2007	86.6	7	**31.5**	**28.0**	**25.4**	21.1	16.6	9.3	5.4	3.5
2008	91.5	9	**41.9**	**33.8**	**28.3**	21.2	16.9	9.0	4.8	3.2
2009	87.4	4	**28.4**	**26.1**	24.1	19.1	15.2	8.5	5.6	3.7
2010	96.1	2	**35.6**	23.0	21.7	18.2	15.2	8.9	5.2	3.4
2011	94.8	0	24.9	20.9	20.0	14.8	12.5	7.4	4.9	3.4

Years with data availability less than 75% are shown in *italics*. Exceedences are shown in **bold**

Table 21: Percentiles of 24-hour PM2.5 at Ti Tree Bend, Launceston (2006 – 2011)

Air NEPM Reporting Standard: 25 µg/m^3 (24 hour average)
8 µg/m^3 (annual average)

Year	Data Availability (% of days)	No. of exceedences (days)	Max. µg/m^3	Percentiles (µg/m^3)						
				99th	98th	95th	90th	75th	50th	25th
2006	92.1	35	**43.6**	**39.9**	**34.6**	**30.5**	**26.3**	13.6	6.3	4.2
2007	86.6	20	**53.6**	**39.7**	**37.3**	**26.5**	20.6	11.4	6.4	4.4
2008	86.1	17	**41.6**	**34.6**	**31.2**	**25.3**	20.3	12.0	5.8	3.4
2009	83.8	12	**36.3**	**32.9**	**29.8**	22.0	14.8	8.9	5.4	3.6
2010	83.3	11	**40.9**	**28.5**	**27.2**	23.7	19.0	9.9	6.1	4.0
2011	86.8	6	**30.4**	**27.5**	**25.6**	20.5	16.2	9.4	5.4	3.8

Years with data availability less than 75% are shown in italics. Exceedences are shown in **bold**

Pollution distribution and trends

Many Tasmanian towns and cities experience their poorest air quality during the cooler autumn and winter months, as a result of smoke pollution from burning fire wood for domestic and industrial heating, as well as vegetation burning for forestry operations and vegetation clearance.

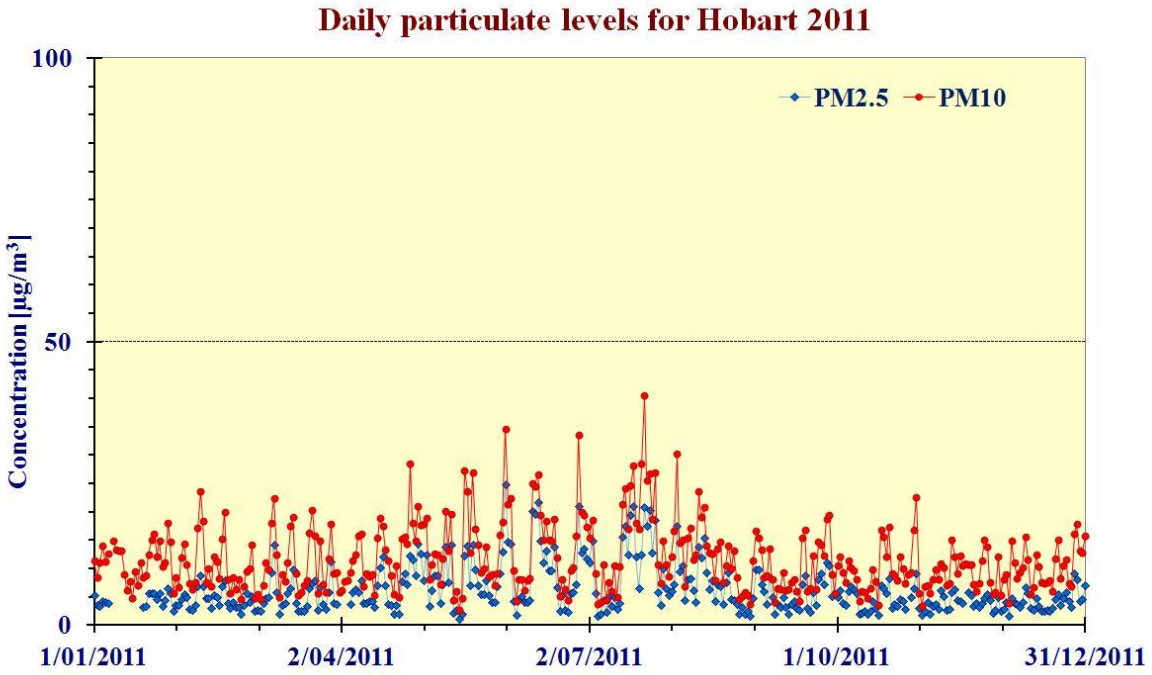

Figure 2. Daily average $PM_{2.5}$ and PM_{10} concentrations measured at New Town in 2011

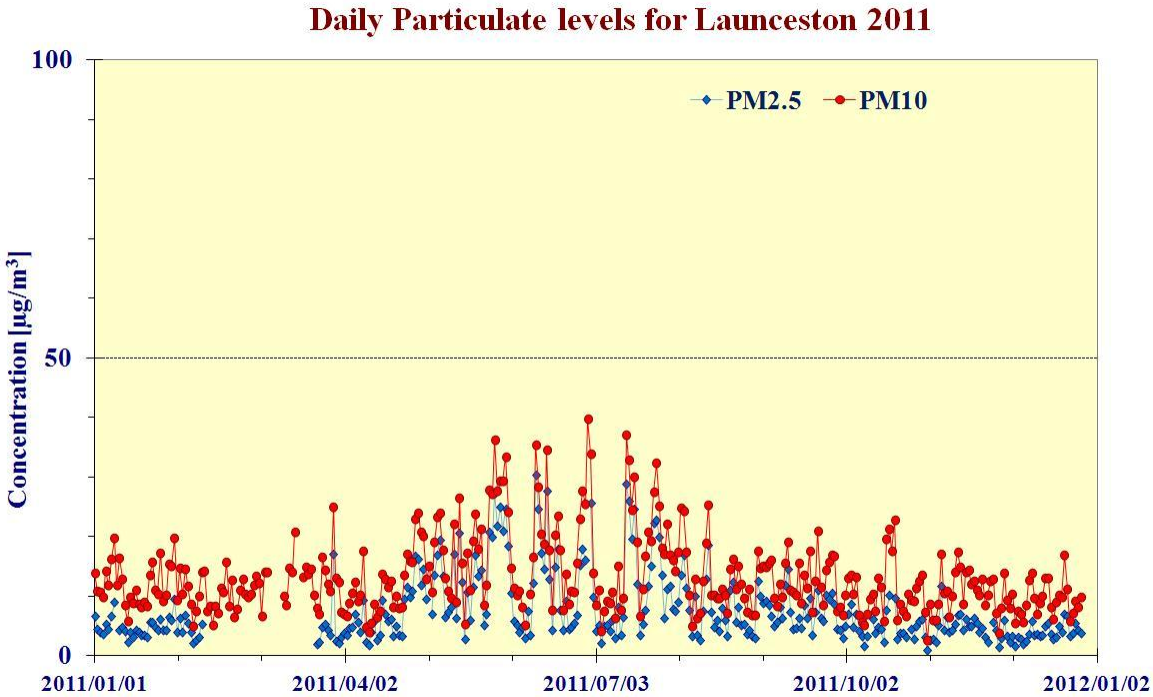

Figure 3. Daily average $PM_{2.5}$ and PM_{10} concentrations measured at Ti Tree Bend in 2011

While the effects of wood smoke can be observed as spikes in the particulate concentrations measured in Hobart (Figure 2) and Launceston (Figure 3) on cold days, the importance of fine particulates in winter air pollution is clearly demonstrated in the annual particulate profiles for Hobart and Launceston since $PM_{2.5}$ monitoring started in 2006 (Figures 4 and 5). These data indicate the $PM_{2.5}$ fraction represented up to 68% of the PM_{10} particulates in Launceston for the high pollution months of May to August, compared to 38% between September and April. The slight rise in the coarse particulate fraction (PM_{10}-$PM_{2.5}$) concentration in summer is probably due to wind-blown dust in dry weather, and a possible increase in sea-salt aerosol loading.

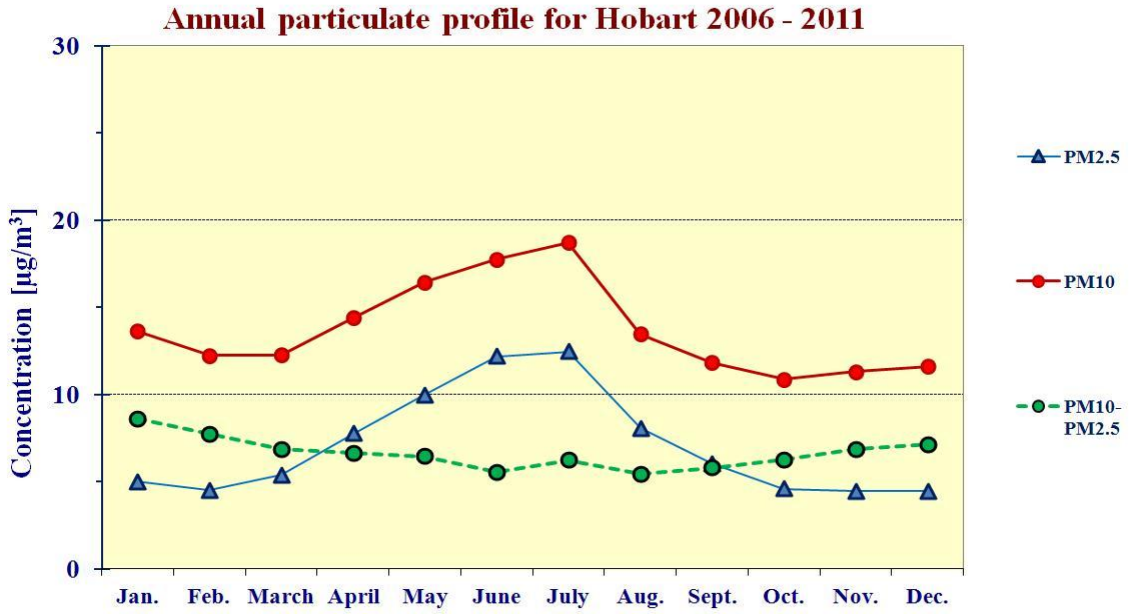

Figure 4. Annual particulate profile, by monthly average, for Hobart (2006 – 2011)

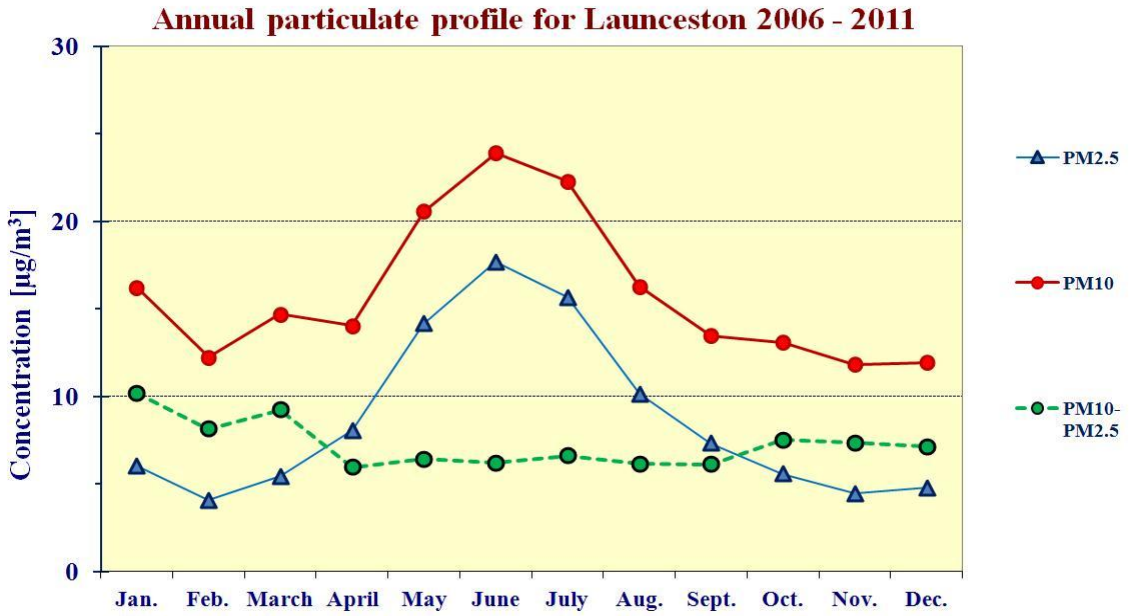

Figure 5. Annual particulate profile, by monthly average, for Launceston (2006 – 2011)

While Launceston still experiences significantly higher levels of winter $PM_{2.5}$ pollution than Hobart, this differential is reduced each year. The reduction in winter smoke pollution in Launceston over the past 2 decades is illustrated in Figures 6 and 7. The frequency of PM_{10} exceedences has declined from 50 days per annum in 1997, to only a single event in 2008 (caused by bushfire smoke), and none in 2009, 2010 and 2011.

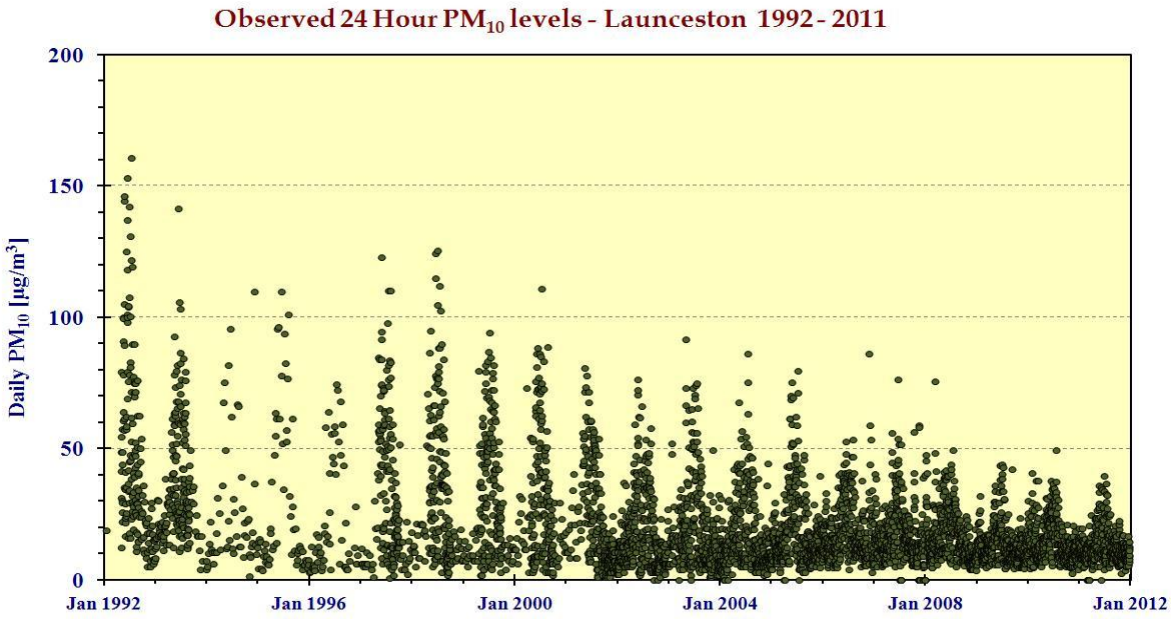

Figure 6. The daily average PM_{10} concentrations measured in Launceston 1992 - 2011.

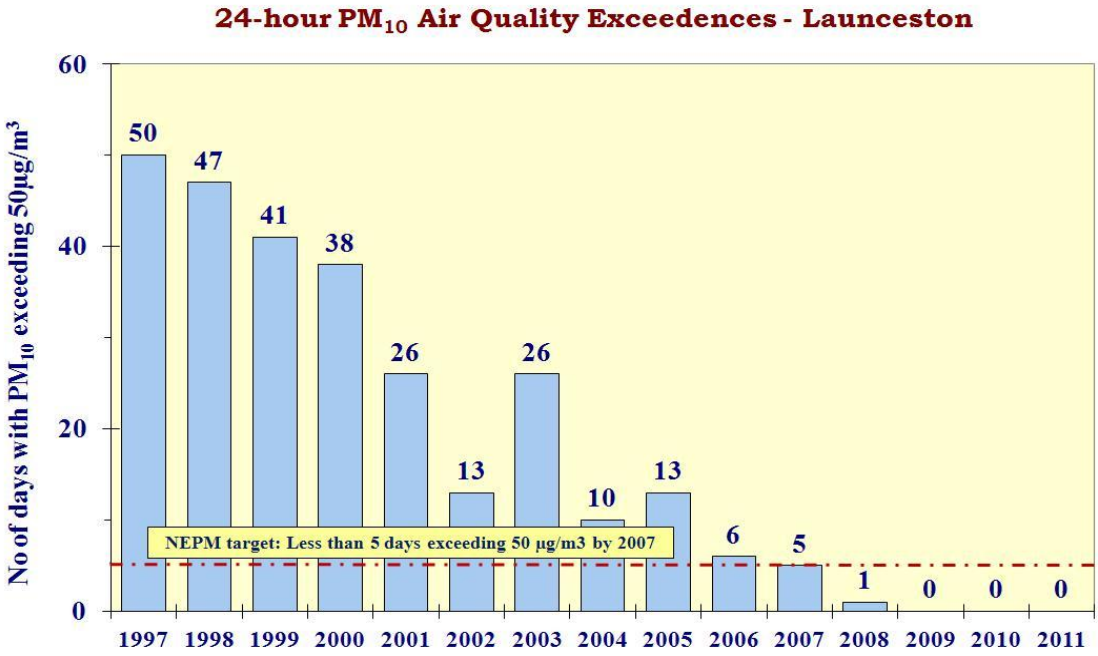

Figure 7. The number of days each year where the 24-hour average PM_{10} concentration at Ti Tree Bend exceeded the Air NEPM standard of 50 µg/m^3, since daily winter monitoring began in 1997.

From Figure 8, it will be observed that the mean autumn-winter PM_{10} concentration (April – September) in Launceston has shown a steady long-term decline from 41 µg/m^3 in 1997 to 15 µg/m^3 in 2011, while the spring and summer (October – March) PM_{10} levels have remained relatively constant between 10 µg/m^3 and 15 µg/m^3 over the same period. However, a similar trend is not observed in Hobart (Figure 9), where there has been no significant change in overall particulate levels since 2002.

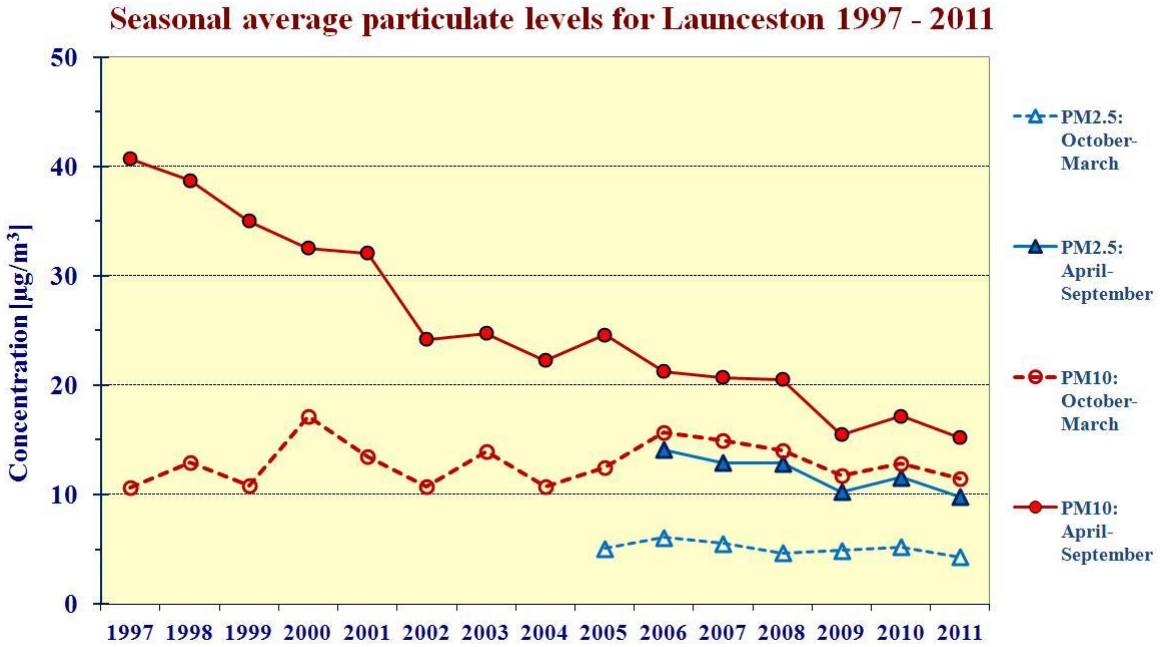

Figure 8. The seasonal average $PM_{2.5}$ and PM_{10} concentrations measured at Ti Tree Bend since regular year-round monitoring of PM_{10} began in 1997

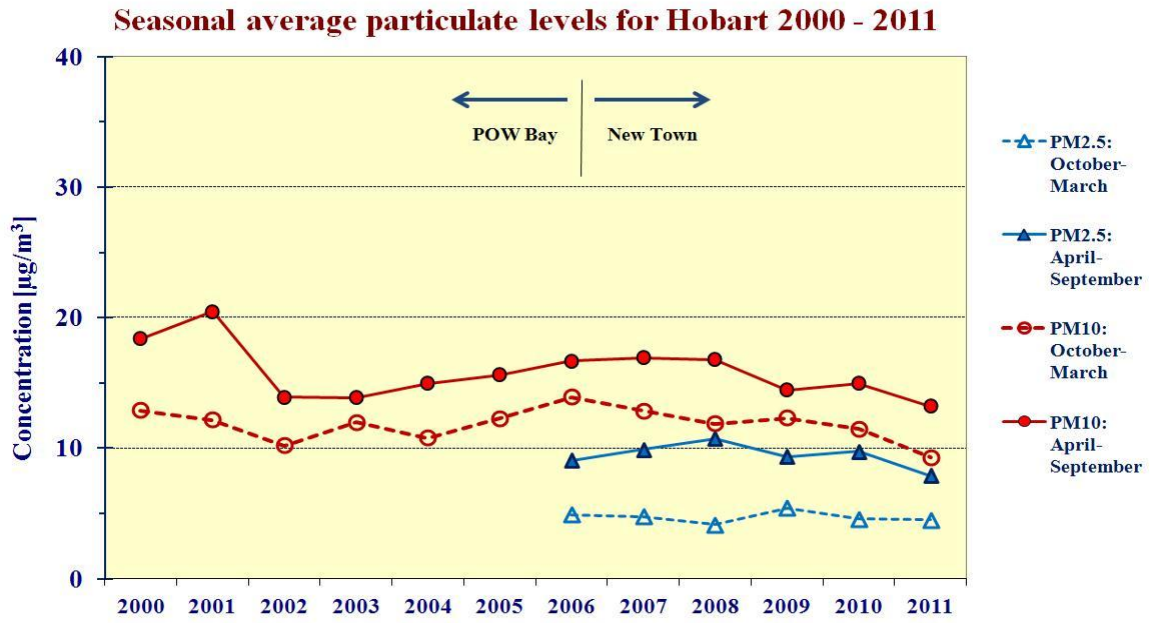

Figure 9. Seasonal $PM_{2.5}$ and PM_{10} concentrations in Hobart since monitoring began in 2000

The available evidence suggests that the improvement in Launceston's air quality over the past decade has been primarily a result of a reduction in the overall emission of wood smoke into the airshed. While meteorological records from Ti Tree Bend do not show any obvious trend in the number of cold days in Launceston each winter over the last 20 years (Figure 10), there has been a substantial reduction in both the number of domestic wood heaters and the consumption of firewood in the city since 2001. Other factors that may have contributed to reduced smoke emissions are:

- reduced individual wood heater emissions through better design, and community education programmes leading to better wood heater operating habits.
- improved smoke management practices by the forestry industry,
- the banning of residential backyard burning and
- the reticulation of natural gas and the conversion of commercial wood-fired boilers.

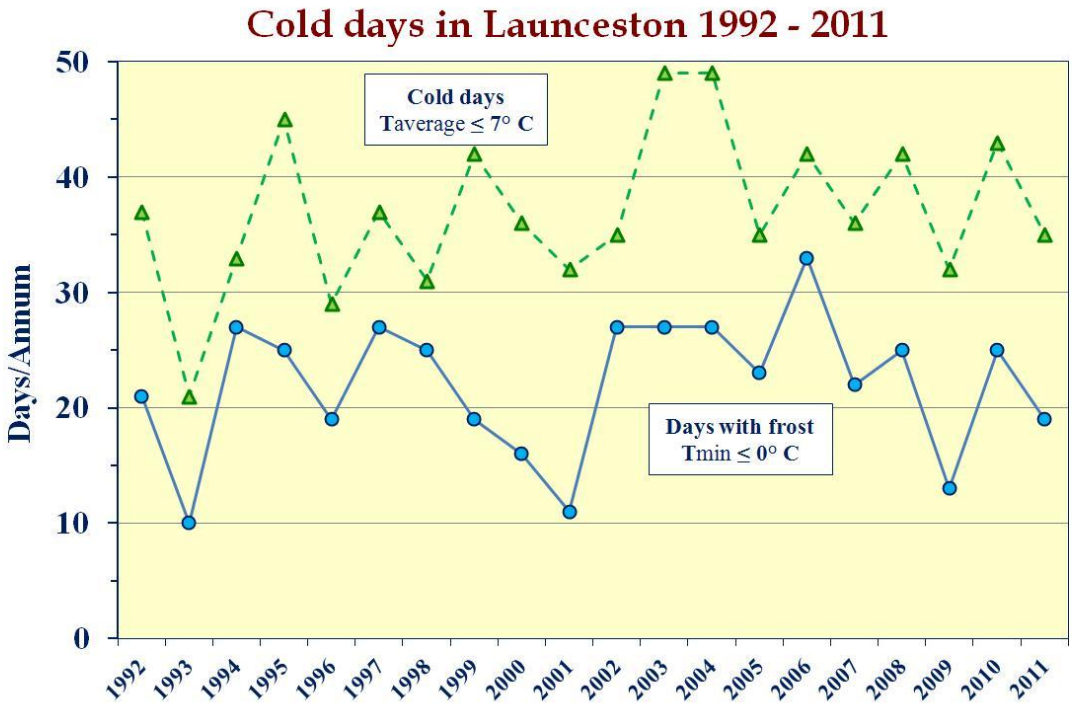

Figure 10. The annual frequency of frosts (minimum temperature ≤ 0°C) and cold days (average temperature ≤ 7°C) measured at Ti Tree Bend 1992 - 2011.

Launceston's winter air quality has shown a dramatic improvement over the past 15 years, and has complied with the NEPM PM_{10} goal for the last 3 years. However, the convergence of the summer and winter seasonal trends illustrated in Figure 8 would indicate that continued progress in improving the city's air quality will become more challenging in the future.

Appendix A: Non-NEPM air monitoring

A-1 Non-NEPM monitoring in Tasmania

The following non-NEPM air quality monitoring programmes are also being conducted in Tasmania.

George Town Air Monitoring Station

The George Town Air Monitoring Station (GAMS), which was established in July 2007 in partnership with the local heavy industries, has been monitoring PM_{10}, $PM_{2.5}$ and levels of SO_2 and NO_x using Low Volume Air Samplers and gas analysers respectively. Continuous particle monitoring is undertaken using an optical Dust Monitor (*GRIMM Aerosol Technik*), which uses assumptions in the optical scattering of the particles to estimate concentrations in the PM_{10}, $PM_{2.5}$ and $PM_{1.0}$ size fractions.

Tamar Valley network

The Rowella monitoring station was established in the central Tamar Valley in 2006 by the Tasmanian Regional Planning and Development Council (RPDC). The EPA Division has continued to operate this Level 2 monitoring station, as part of the baseline environmental studies required prior to the construction of the proposed pulp mill at Longreach. During 2010, this station has continued to monitor $PM_{2.5}$ and PM_{10} particles using TEOM instruments, and also monitor the levels of sulphur dioxide, and oxides of nitrogen using gas analysers. The remaining Microvol^{TM} air samplers and passive hydrogen sulphide monitoring stations in the Tamar Valley (Beauty Point, Deviot, Riverside, Rowella and Tippogorrie Hills) were decommissioned during 2010, although meteorological data continue to be collected at these sites.

BLANkET network

In 2009 the Environment Division of the Department of Environment, Parks, Heritage and the Arts (DEPHA), now the EPA Division of DPIPWE, commenced the establishment of a regional network of air monitoring stations to determine the effects of forestry and agricultural burning, domestic wood-heating, and other smoke-generating activities on air pollution levels over a representative sample of the state.

This network – *Base-Line Air Network of EPA Tasmania* (BLANkET) - currently consists of 19 stations equipped with optical particle (DRX dustrak) and meteorological instruments. The locations of the Tasmanian air monitoring stations, including the BLANkET stations, are shown in Figure 11. Real-time indicative PM_{10}, $PM_{2.5}$, and meteorological data are available on the EPA Division's website at http://www.environment.tas.gov.au/?base=7747 .

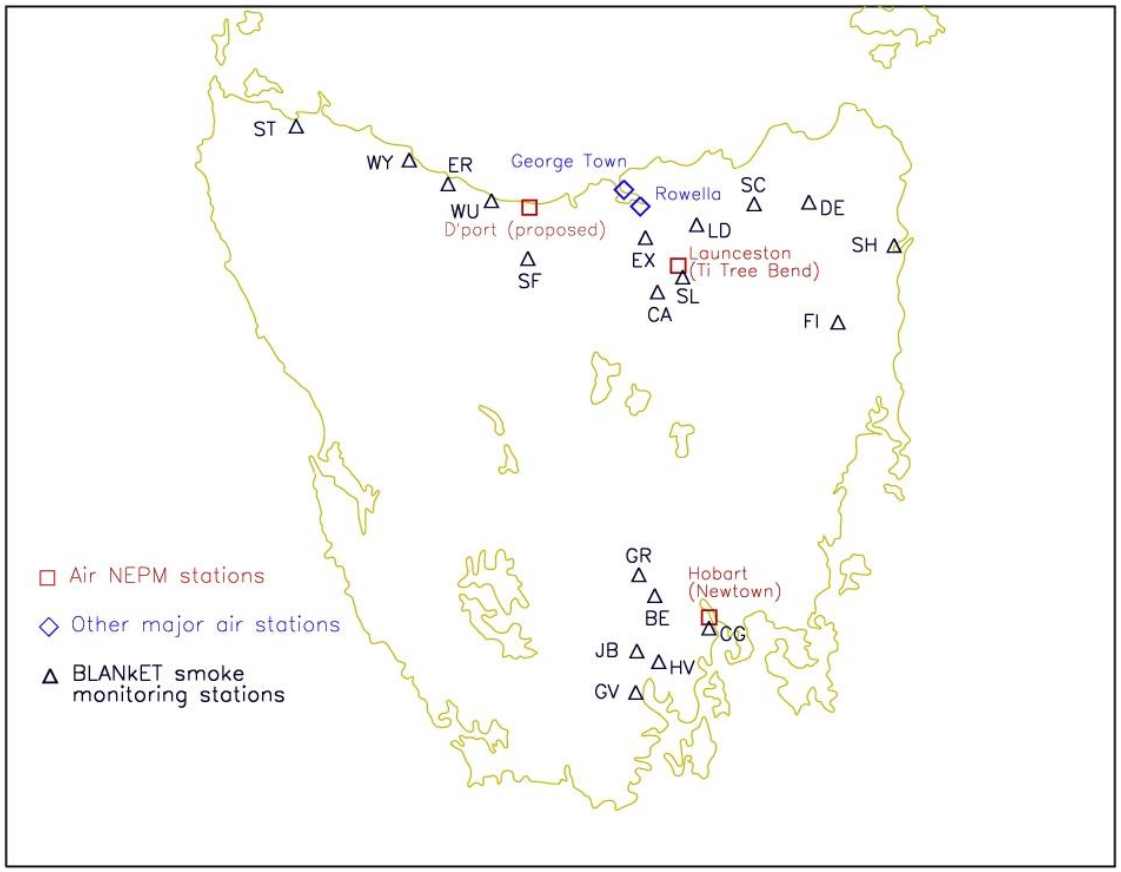

Figure 11 – Tasmania air quality monitoring stations 2010. The BLANkET stations are indicated by black triangular symbols.

The BLANkET stations are located near communities that are likely to be affected by smoke from planned burn operations, and to provide air quality monitoring over a large proportion of Tasmania. These stations have significantly improved knowledge of smoke transport over Tasmania, and provide valuable insights into winter wood smoke levels (from domestic heating) in several of the smaller Tasmanian communities. Details of the instrumentation and results of analysis of the network data are presented in reports available at http://www.environment.tas.gov.au/index.aspx?base=7529 .

Two examples of planned burn smoke impacts are briefly discussed here. The first example occurs on the night of the 21st/22nd April 2010 at the Emu River station, 5 km south of Burnie. It recorded very high $PM_{2.5}$ levels overnight, shown in Figure 12. Instantaneous (10-minute resolution) levels peaked at just under 1000 µg/m^3. For a number of hours $PM_{2.5}$ was over 300 µg/m^3. The full analysis of this event is still in progress, but there is evidence that the cause was partly due to smoke from a 10 ha forest industry burn inland from Burnie undertaken on the 21st of April. A well-defined katabatic flow down the Emu River valley was likely to have entrained the smoke plume thus limiting smoke dispersal.

The second example occurs in mid April 2010 in the Huon region of southern Tasmania. In this case there was significant smoke build-up over several days due to numerous forest-industry burns in the region. The three BLANkET stations in the Huon recorded the increase in particle concentrations. Day-averaged $PM_{2.5}$ data from these stations for April 2010 are

shown in Figure 13, along with estimated daily burn totals (in kilotonnes) in the Huon airshed. Smoke dispersal in mid-April was limited due to calm atmospheric conditions. There is a marked similarity in mid-April between burn loads on a given day and the measured day-averaged $PM_{2.5}$ values on the following day. Many of the burns were ignited in the afternoon, and the full smoke impacts at the air stations were often not seen until after midnight.

Anecdotal evidence suggests that such events have occurred in the Huon and elsewhere in Tasmania in the past. These 2010 data were the first quantitative measurements of the smoke impacts resulting from several days of intensive forest burning during conditions of limited smoke dispersion. Feedback from forest-industry indicates that the monitoring data have been very informative. Furthermore, the data and knowledge gained from the BLANkET network is synthesised by the Smoke Management Working Group of the Forest Practices Authority to improve the management of smoke from planned burns.

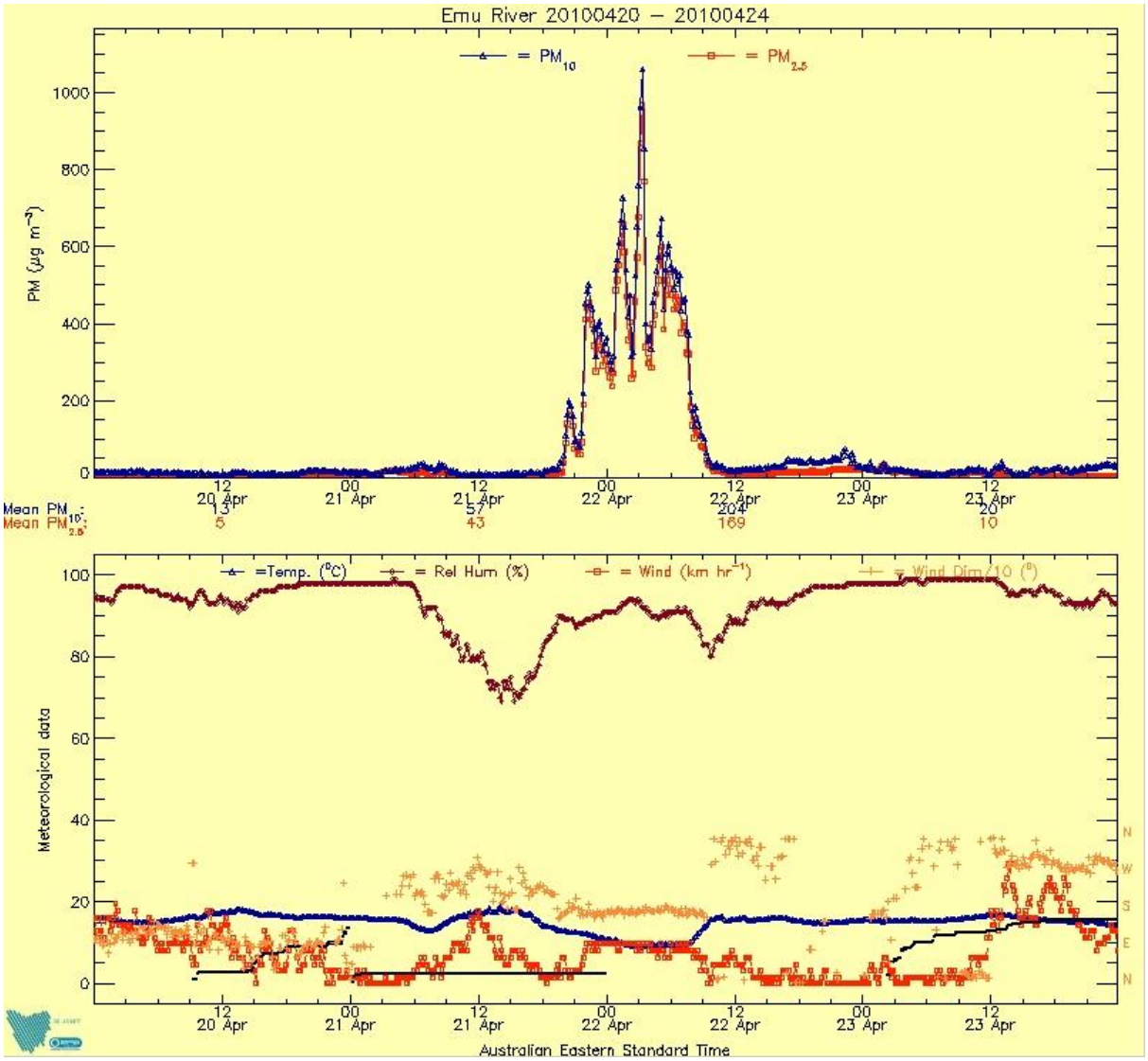

Figure 12 – Data from the BLANkET station at Emu River (near Burnie), 20-23 April 2010. Very high smoke concentrations were recorded on the night of the 21st - 22nd of April during an interval of katabatic wind.

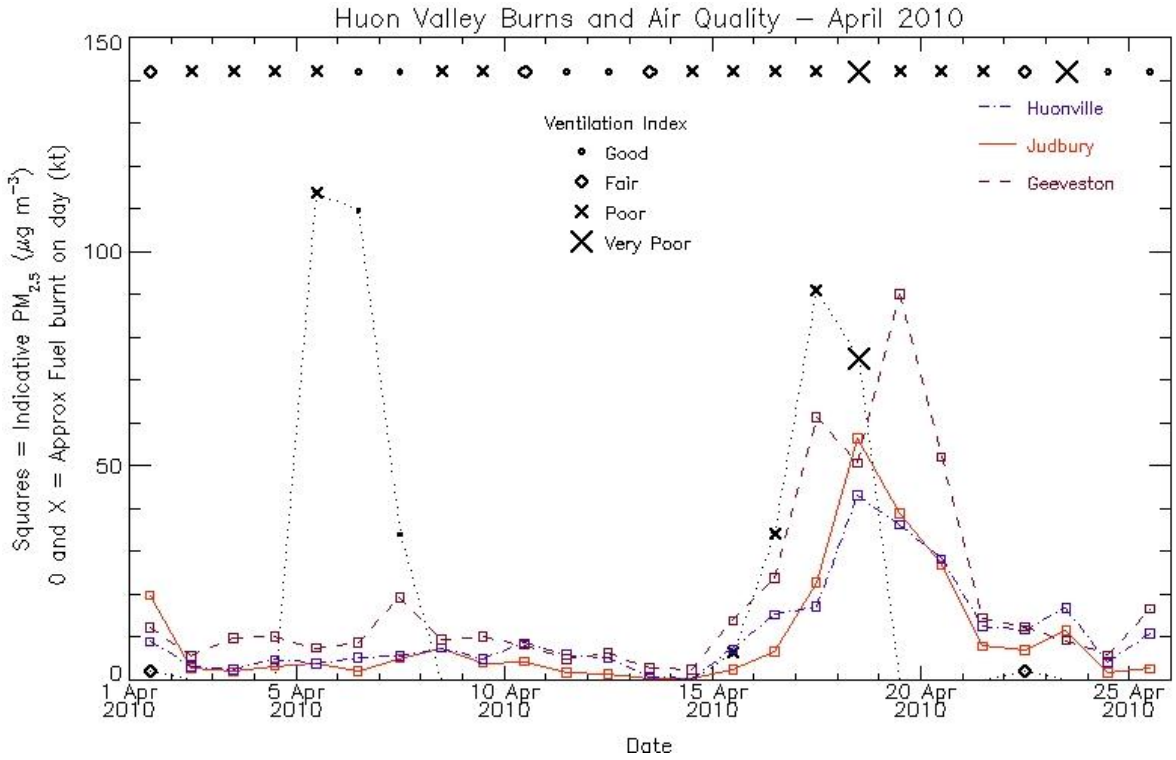

Figure 13 – Day averaged $PM_{2.5}$ values from the three Huon region BLANkET stations and estimated daily forest-industry burn-loads, April 2010. Air quality data are shown for Huonville (dot-dashed-line), Judbury (solid line), and Geeveston (dashed line). Daily burn loads are shown as the dotted line with symbols representing the calculated daily ventilation index, which is a measure of atmospheric mixing. The mid-April burns were conducted on days of poor to very poor ventilation index.

Other findings from the BLANkET network have highlighted that very poor air quality can be experienced even in small Tasmanian communities in winter time due to smoke from domestic wood-heaters. Figure 14 shows the day-averaged $PM_{2.5}$ data from Geeveston for April to September 2010. This region has a population of approximately 800 in the town itself, and a similar number in the surrounding areas. The mid-April increase coincides the forest-industry planned burns discussed above. The elevated levels seen from late May to early September are primarily due to smoke from local domestic wood-heaters. Geeveston township is largely surrounded by low hills, and frequently experienced cold nights in winter 2010. It is likely that a temperature inversion layer often forms at night in cold weather, which together with the local topography acts to limit smoke dispersion.

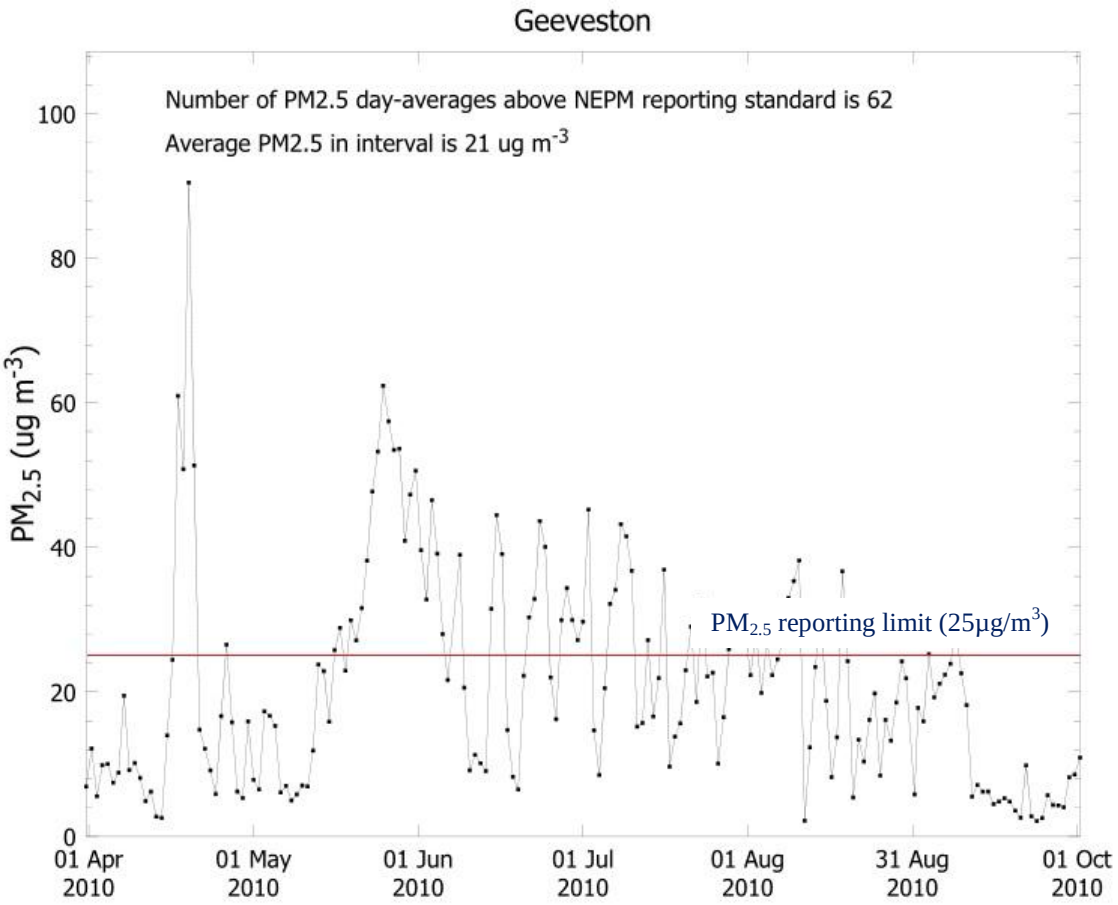

Figure 14 – Day-averaged $PM_{2.5}$ values from the Geeveston BLANkET station, April to September 2010.

An analysis of the winter 2010 BLANkET data showed that Geeveston regularly recorded the poorest air quality of all 15 stations. However, not all BLANkET stations are located in or near residential areas such as Geeveston. Thus, there was a clear need to obtain air quality data from towns and communities elsewhere in Tasmania to identify other localities of poor winter time air quality.

In consequence, a car-based monitoring system was developed, namely Travel BLANkET, consisting of a DRX dustrak with heated inlet, a GPS, and a PC data logger. Smoke surveys were undertaken in several Tasmanian towns in late winter 2010, including Geeveston and Huonville where BLANkET stations are co-located. Figure 15 shows the result of one survey in New Norfolk from September 2010. . This region is situated in the Derwent Valley and the results are displayed via Google Earth. The colour of the circular symbol and its height above local ground represent the measured $PM_{2.5}$ value. The peak values were over 200 $\mu g/m^3$, and many readings were over 100 $\mu g/m^3$. The general spatial distribution of the smoke shown in this figure has been confirmed from subsequent surveys. It is clear that New Norfolk can experience very poor air quality in the colder months of the year. This is likely due to smoke from domestic heaters. The survey work has proved to be extremely

informative such that further surveys are planned. The information will be provided to local government as part of work to reduce ambient smoke concentrations in Tasmania.

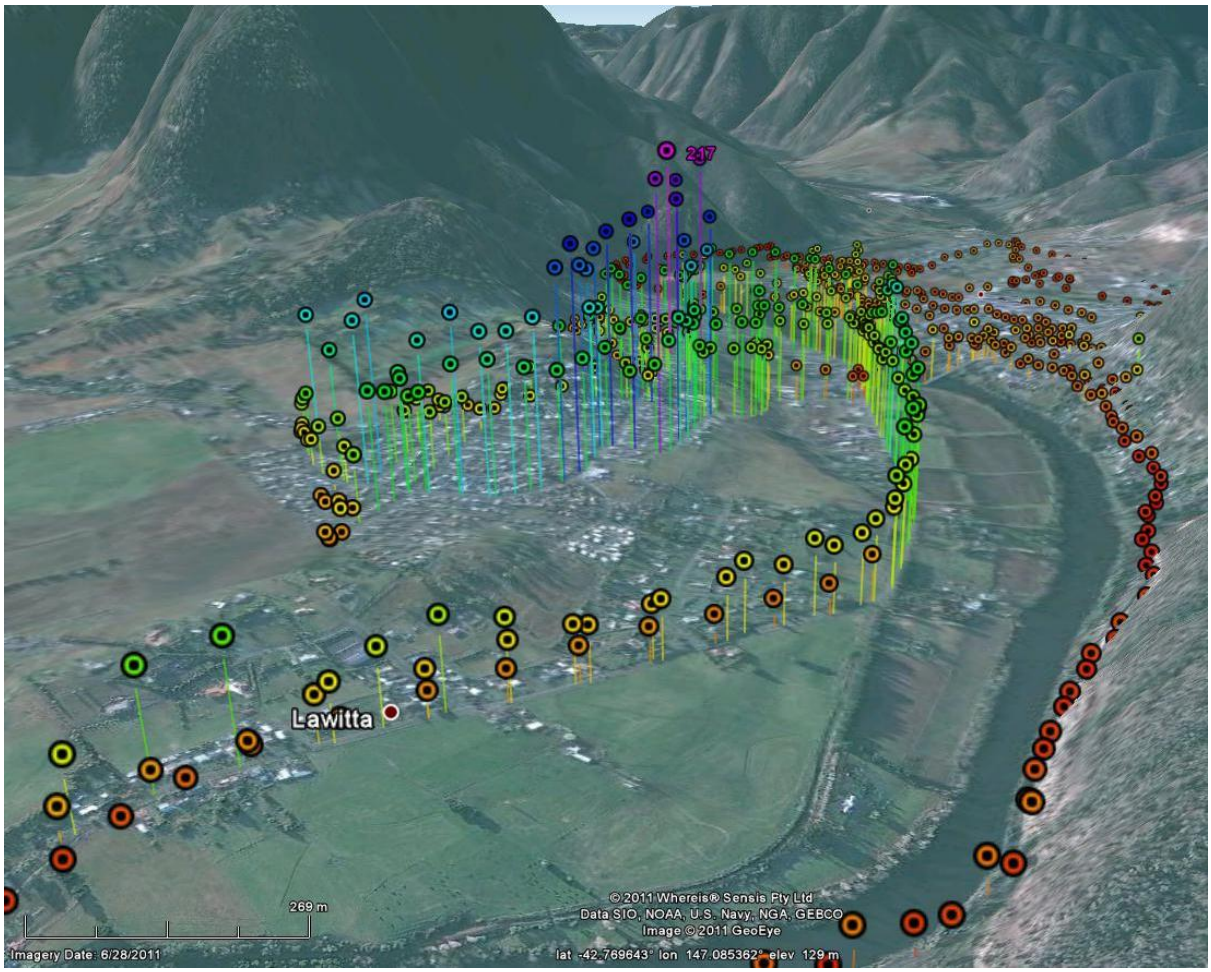

Figure 15 – Travel BLANkET $PM_{2.5}$ survey results for New Norfolk, from the evening of 8th September 2010, viewed in Google Earth. The colour of the circular symbols and their height above local ground level represent the $PM_{2.5}$ value. The peak values were over 200 µg/m^3.

Appendix B – Overview of NEPM monitoring regions

B-1 HOBART

1.1 Region Boundaries

The extent to which pollutants emitted in a given area can impact on air quality elsewhere depends on a number of factors, including topography, meteorology and the chemical and physical properties of the pollutants. The term "airshed" is commonly used to refer to an area that is defined by natural or topographic features affecting air quality.

In the case of a secondary pollutant (i.e. one that is formed by chemical reactions in the atmosphere, rather than being directly emitted, e.g. O_3), the airshed may extend relatively large distances from the city centre. However, for a pollutant such as PM_{10} in winter, the extent of influence may be more localised and perhaps confined to areas sharing common nocturnal-drainage airflows.

For the purpose of the Measure, the Hobart Region boundaries are defined as presented in Figure 13. Although there is no functional purpose served in exactly defining the boundary Australian Map Grid (AMG) co-ordinates, these may be taken to be defined by the south-west corner (Easting 500,000; Northing 521,000) and the north-east corner (Easting 550,000; Northing 5290,000).

1.2 Population and Topography

The population density and topography for the Hobart Region are presented in Figure 13. The city of Hobart is located on the narrow coastal plain of the Derwent valley, flanked by a complex terrain of hills and mountain ranges. The majority of the region's population of 214,705 (ABS, 2010) reside within a 10 kilometre radius of the Central Business District (CBD) as illustrated in Figure 1, with significant satellite urban centres at Kingston-Blackmans Bay to the south (pop 29,000), and both Bridgewater-Gagebrook (pop. 14,000) and New Norfolk (pop. 6,800) to the north.

1.3 Meteorology

The prevailing wind direction across Tasmania is northwest, strongly modified by the complex mountainous terrain surrounding the Derwent valley. The city experiences unstable frontal conditions late winter through early summer the (July-Dec) and stable anti-cyclonic conditions the remainder (Jan-June). During these latter periods, the wind flows are dominated by the katabatic drainage winds flowing down the Derwent Valley during the night and early mornings, and a south-easterly sea breeze on warm afternoons. In clear, calm autumn and winter weather, relatively high levels of locally generated air pollution can be trapped in hollows and basins.

1.4 Hobart, Performance and Trend Monitoring Station

The Performance and Trend air monitoring station for Hobart was established in June 2000 at the Prince of Wales Bay sports field, approximately 6km WNW of the Hobart CBD in the northern suburb of Glenorchy. In May 2006, following the review of the Tasmanian Air Monitoring Plan in 2005, a new Performance and Trend air monitoring station was established 2.5 km closer to the CBD at a more representative site in New Town (Figure 16).

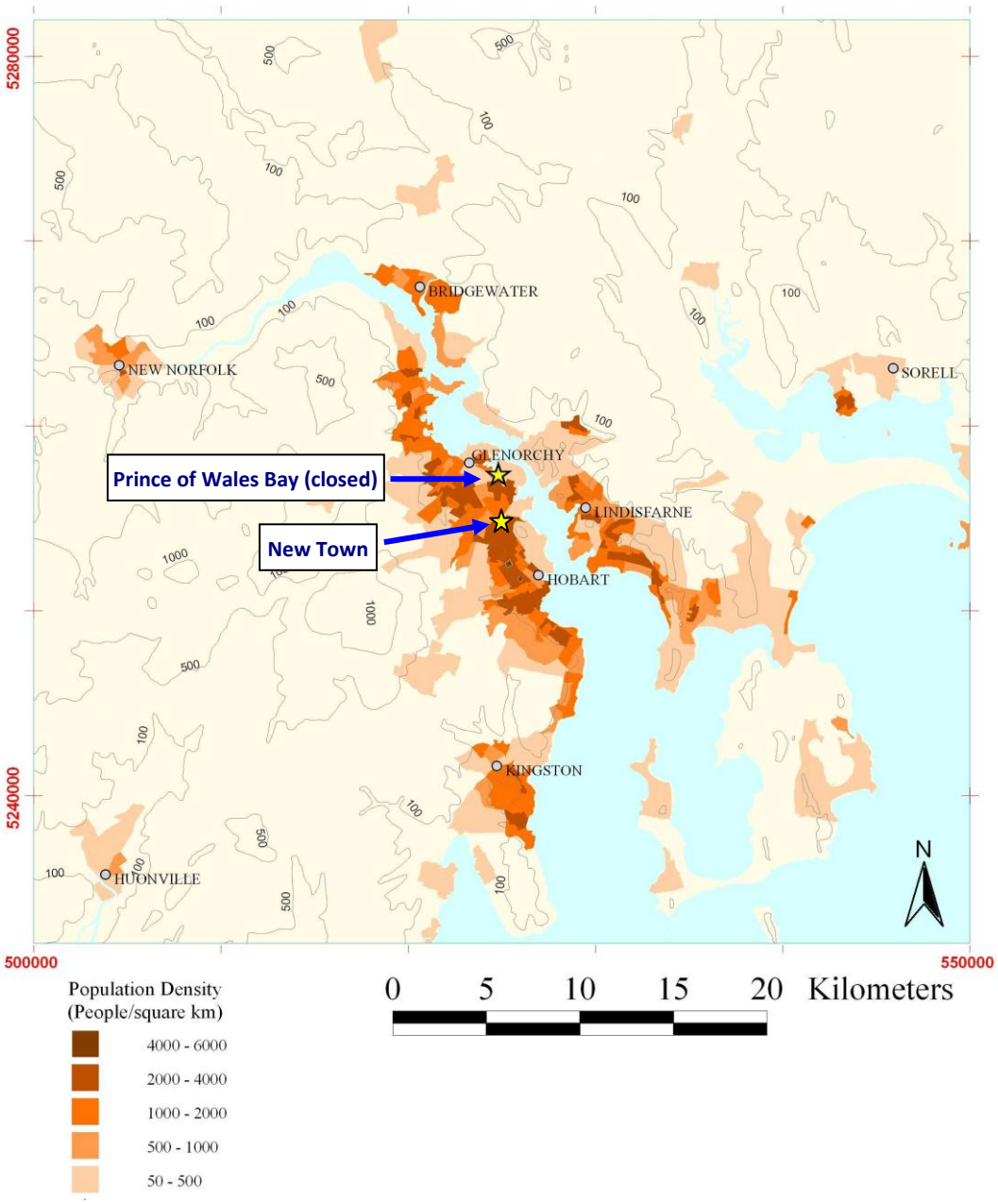

Figure 16 - Map of the Hobart Region, showing the Population Density, Topography and the location of the NEPM Air Monitoring Stations. The Prince of Wales Bay Air Station was closed in mid 2006 when the New Town station commenced operation.

1.4.1 New Town Station

In May 2006, the Environment Division moved the primary *Hobart Performance and Trend Monitoring Station* to a property in New Town leased by the Hockey Association of Tasmania, some 2.5 km SSE of the original station. The new station incorporates a PM_{10} TEOM, plus an Andersen RAAS low volume sampler for each of PM_{10} and $PM_{2.5}$, as well as one 8520 *DustTrak*™ and two 8533 DRX *DustTrak*™ particle counters for continuous indicative monitoring of particle concentrations. The choice of this site was supported by

TAPM modelling of the greater Hobart airshed, which predicts elevated smoke concentrations in the areas illustrated in Figure 17.

The following were measured at the New Town station in 2011:

- $PM_{2.5}$ measured by Andersen RAAS™ low volume air sampler (LVAS), according to AS 3580.9.10-2006, sampled every day.
- PM_{10} measured by Andersen RAAS™ low volume air sampler (LVAS), according to AS 3580.9.9-2006, sampled every day.
- PM_{10} by a TEOM direct-reading instrument.
- $PM_{2.5}$ via a second TEOM with a Size Selective Inlet and Very Sharp Cut Cyclone. This was installed and commissioned in late 2010. The TEOM $PM_{2.5}$ data came on-line from 1/1/2011.

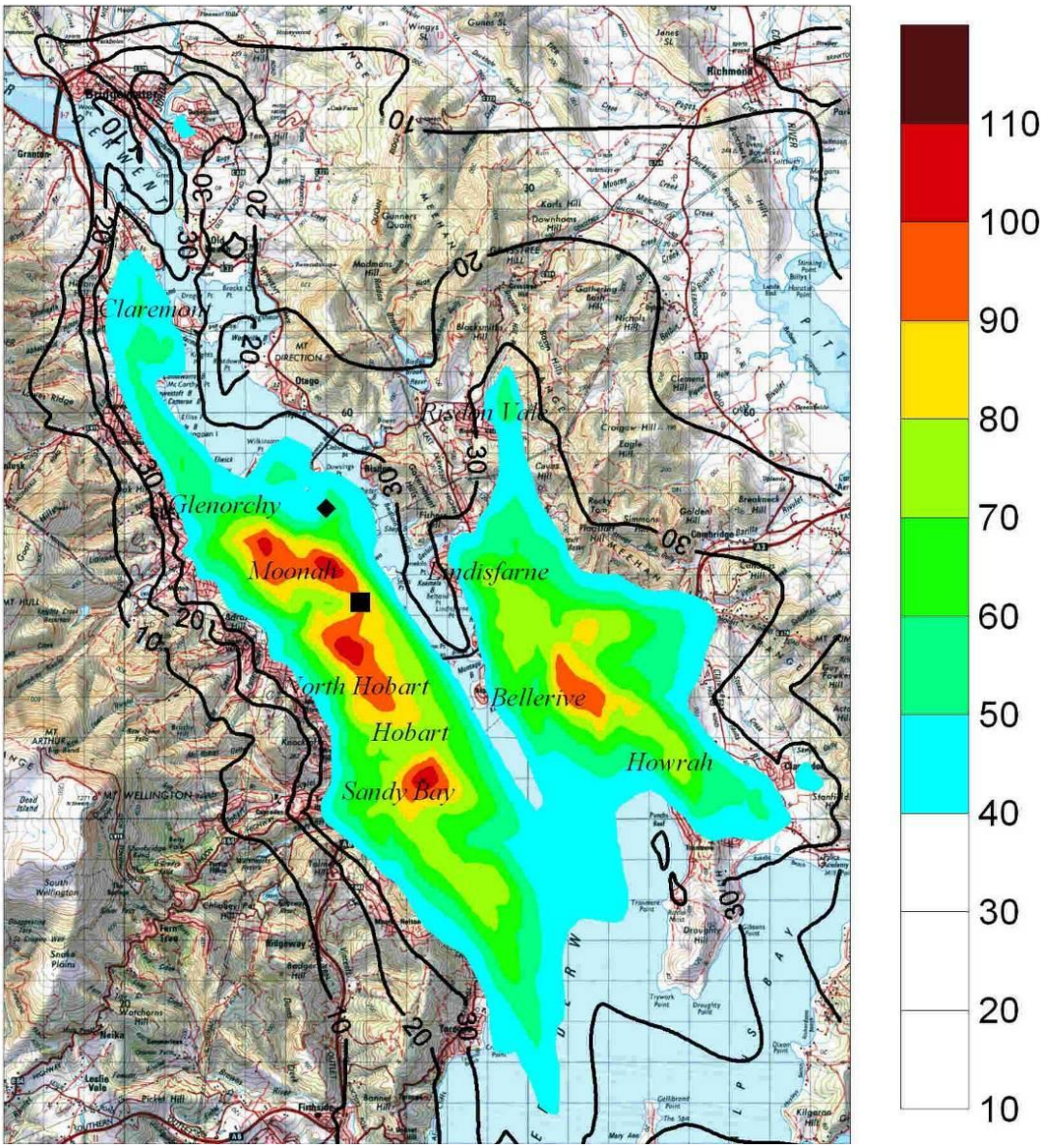

Figure 17. Results of preliminary modelling of maximum 24 hr average PM_{10} concentrations in the Hobart region, showing indicative "hot-spots" (in red) for particles. The black square and diamond symbols respectively represent the locations of the current Newtown and former Prince of Wales Bay air monitoring station.

B-2 LAUNCESTON

2.1 Region Boundaries

Launceston and the Tamar Valley as a whole have been well studied in terms of the meteorology and atmospheric dispersion of the region. Results of three-dimensional atmospheric dispersion modelling in the Tamar Valley Airshed Study (DELM, 1995), have indicated that emissions from heavy industry at Bell Bay, some 40 kilometres north-west of Launceston, may occasionally have a minor impact on air quality in Launceston under unfavourable weather conditions.

For the purpose of the Measure, the Launceston Region boundaries are defined as presented in Figure 3 and cover an area approximately 40 kilometres wide and 60 kilometres long. This area has been selected for consistency with the Tamar Valley Airshed Study (DELM, 1995). Although there is no functional purpose served in exactly defining the boundary AMG co-ordinates, these may be taken to be defined by the south-most corner (Easting 501,250; Northing 5,389,750) and the north-most corner (Easting 498,750; Northing 5,467,250).

2.2 Population and Topography

The population density and topography of the Launceston Region is presented in Figure 18.

The total population of the Launceston Region as defined in the *Air Monitoring Plan for Tasmania*, and illustrated in Figure 15, is approximately 106,153 (ABS, 2011). The city of Launceston is located on the upper reaches of the Tamar River, in a well-defined valley that extends some 50 kilometres north to Bass Strait. The valley axis is mostly aligned in a north-west to south-east orientation and is flanked by hills that reach heights of up to 400-m.

Most of Launceston's urban population of 64,000 is located within approximately five kilometres of the city centre, with the highest densities located south-east of the city centre, and significant densities on the banks of the Tamar River to the north and north-west of the city.

George Town, near the mouth of the Tamar river, is the second largest urban centre in the region with a population of 6,700. While the population of George Town is below the threshold for the installation of an ambient air monitoring station under the *National Environment Protection (Ambient Air Quality) Measure (2003 – hereafter "Air NEPM")*, an industry-government funded air monitoring station has been operating on the southern edge of George Town since July 2007.

The $PM_{2.5}$ and PM_{10} levels in the Launceston region are also monitored by two TEOMs at the Rowella station in the central Tamar Estuary, as shown in Figure 18. The PM_{10} *microvol*™ air samplers at the Level 1 stations shown in Figure 18, (Beauty Point, Deviot, Riverside-Trevallyn, Rowella and Tippogorree Hills) were decommissioned during the year.

The data from these non-NEPM stations are not included in this report.

2.3 Meteorology

The prevailing winds tend to be northerly all year round in Launceston, with atmospheric calm conditions reported to be most frequent in the autumn and winter months (Power, 2000).

Available data for the Launceston region clearly indicate that high concentrations of particles are frequently associated with light winds and highly stable atmospheric conditions. Moreover, because of night-time ground radiative cooling and the formation of drainage flows, relatively high pollutant concentrations are likely to be found in topographic hollows and basins, and on low-lying land.

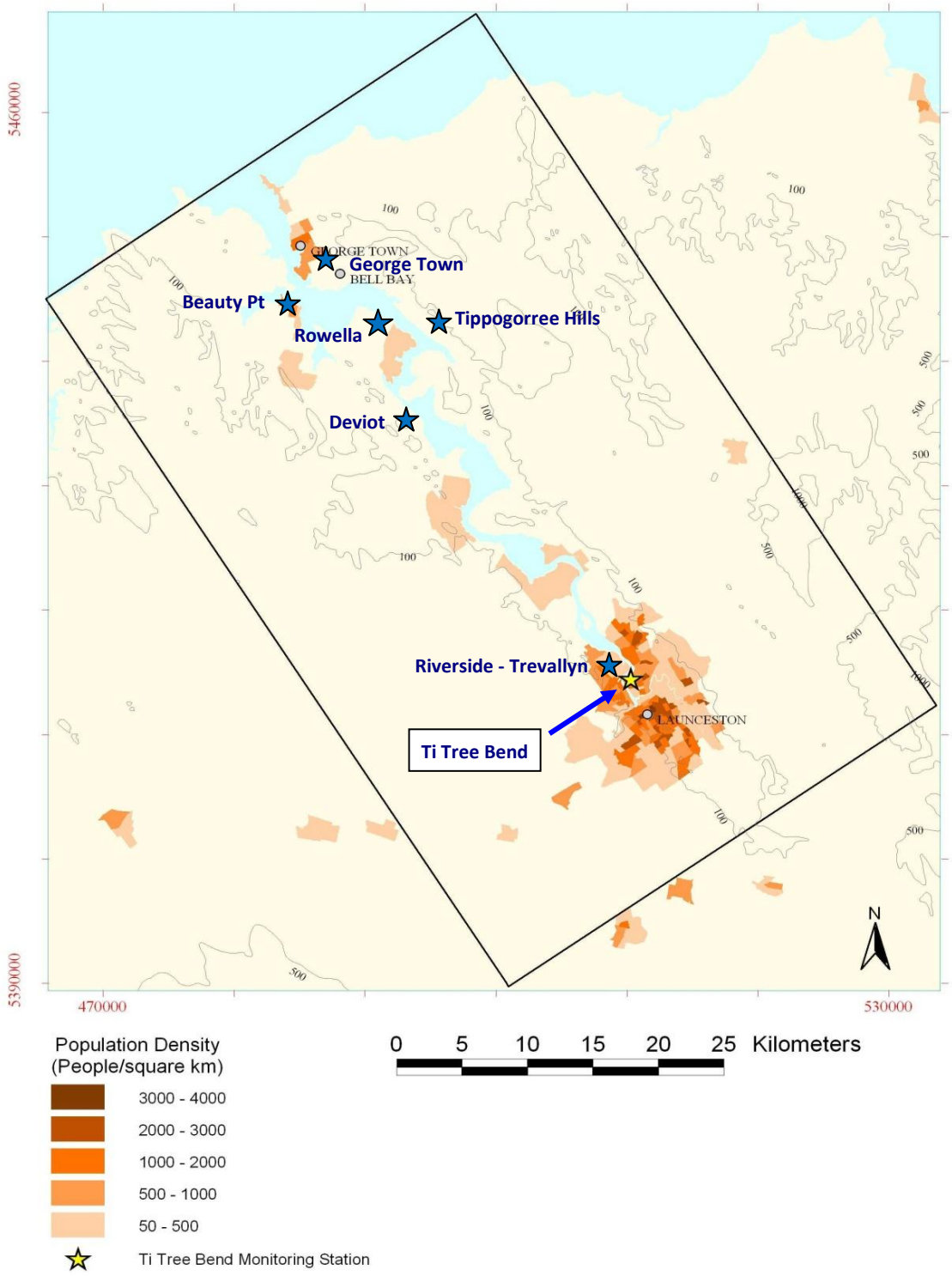

Figure 18 - Map of Launceston Region showing the Population Density, Topography and the location of Air Monitoring Stations, including the Air NEPM monitoring station at Ti Tree Bend.

2.4 Launceston, Ti Tree Bend Performance and Trend Monitoring Station.

Seasonal PM_{10} measurements using a High Volume Air Sampler have been collected at Ti Tree Bend since 1992, with year round sampling commencing in 1997. The station was established in the grounds of the Launceston Council Waste Water Treatment Plant, on the banks of the Tamar River, some 170 metres from the Launceston Weather Station operated by the Bureau of Meteorology, as illustrated in Figure 19. This station was upgraded in March 2002 with the installation of a PM_{10} TEOM, a permanent station building in 2004, and the installation of Andersen RAAS™ Low Volume Air Samplers (LVAS) for $PM_{2.5}$ and PM_{10} in August 2005 as part of the *Tasmanian Air Quality Monitoring System Development Project, 2004-2008*.

Figure 19 - Satellite image of the Ti Tree Bend Waste Water plant showing the old and new positions of the Ti Tree Bend Air NEPM monitoring station.
(Image from Google Earth.)

As noted in the 2008 NEPM Annual Report on Ambient Air Quality for Tasmania, the Ti Tree Bend air monitoring station was moved on the 16th of December 2008 to a more suitable site in the NE corner of the waste water treatment plant away from the very localised dust contamination problems associated with sludge transfer operations. Several existing trees at the new station site were removed to comply with the requirements of **AS2923** (*Ambient air - Guide for the measurement of horizontal wind for air quality applications*) and **AS3580** (*Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment*).

The following were measured at the Ti Tree Bend station in 2010.

- $PM_{2.5}$ measured by Andersen RAAS low volume air sampler (LVAS), according to AS 3580.9.10-2006, sampled every day.
- PM_{10} measured by Andersen RAAS low volume air sampler (LVAS), according to AS 3580.9.9-2006, sampled every day.
- PM_{10} via collocated TEOM direct-reading instrument.
- $PM_{2.5}$ via second TEOM with a Size Selective Inlet and Very Sharp Cut Cyclone. This was installed during the second half of 2010, with the data coming on line from 1st January 2011.

B-3 DEVONPORT

3.1 Region Boundaries

For Devonport, the availability of meteorological data tends to be relatively low. Moreover, comprehensive atmospheric dispersion models have not been developed for the Region. For these reasons, the extent of the Devonport airshed is unclear.

For the purpose of the Measure, the Devonport Region boundaries are defined as presented in Figure 6. Although there is no functional purpose served in exactly defining the boundary MGA co-ordinates, these may be taken to be defined by the south-west corner (Easting 441,000; Northing 5430,000) and the north-east corner (Easting 454,000; Northing 5444,000).

3.2 Population and Topography

The population density and topography for the Devonport Region is presented in Figure 20. The majority of the population resides within approximately a 5 km radius of the CBD. In total, the population of the Devonport Region as defined in the *Air Monitoring Plan for Tasmania* is approximately 33,500 (ABS 2006).

Devonport is located in a shallow coastal plain on the banks of the Mersey River. The Mersey River connects the town of Latrobe with Devonport.

3.3 Meteorology

Westerly winds tend to prevail in the Devonport Region, with atmospheric calm conditions most frequent in autumn and winter..

Strongly stable atmospheric conditions in Devonport are normally associated with southerly, south-easterly or easterly winds draining out of the Valley. This is especially evident in winter.

3.4 Devonport Performance And Trend Monitoring Station

Campaign monitoring of particles was completed at the Devonport High School in 2003 to assess the need for a permanent station in Devonport. The results of this survey confirmed that central Devonport experienced elevated levels of PM_{10} air pollution during the winter months, which could exceed the 50 $\mu g/m^3$ NEPM 24-hr standard under calm atmospheric conditions. Initial plans to install a permanent monitoring station at the grounds of the Devonport High School in 2007 could not proceed due to limited resources, together with engineering and administrative difficulties related to student safety and site access.

Negotiations are continuing with owners of alternative sites in the south west of the Devonport CBD, with the aim of commissioning a Devonport station in 2011.

A transportable station building and suitable monitoring instruments have been acquired to measure the following air quality parameters at the Devonport site:

- $PM_{2.5}$ measured by sequential Low Volume Air Sampler (LVAS), according to AS 3580.9.10:2006, sampled every day.
- PM_{10} measured by sequential Low Volume Air Sampler (LVAS), according to AS 3580.9.9 :2006, sampled every day.
- $PM_{2.5}$ and PM_{10} via collocated TEOM direct-reading instruments. (PM_{10} according to AS3580.9.8:2008.)

Figure 20. Satellite image of Devonport showing the location of the air monitoring station. (source: Google Earth)

APPENDIX C: REFERENCE METHODS

Australian standard methods

The reference methods specified in Schedule 3 of the *Air NEPM* for determining PM_{10} particulate concentration in ambient air are:

AS3580.9.6–1990	Determination of Suspended Particulate Matter – PM_{10} High Volume Sampler with Size Selective Inlet – Gravimetric Method.
AS3580.9.7-1990	Determination of Suspended Particulate Matter - PM_{10} Dichotomous Sampler – Gravimetric method

Advances in air sampler technology and the requirement to measure smaller particulate size fractions have seen the widespread adoption of US EPA compliant low volume air samplers as the preferred method for the measurement of PM_{10} and $PM_{2.5}$ in ambient air. These techniques are now recognised by the following Australia/New Zealand standards:

AS3580.9.9:2006	Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM10 low volume sampler - Gravimetric Method.
AS3580.9.10:2006	Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM2.5 low volume sampler - Gravimetric Method.

The Thermo-Electron/Andersen RAAS and Partisol sequential low volume air samplers used by the Environment Division are recognised as Reference Methods for $PM_{2.5}$ and PM_{10} monitoring in the US EPA *List of Designated Reference and Equivalent Methods* (www.epa.gov/ttn/amtic/criteria.html). Details are provided in the following table:

Air Sampler	Size	USEPA Approval No.
Andersen Model RAAS10-300	PM_{10}	Manual Reference Method RFPS-0699-132
R&P Partisol®-Plus Model 2025	PM_{10}	Manual Reference Method RFPS-1298-127
Thermo-Electron Model RAAS2.5-300	$PM_{2.5}$	Manual Reference Method RFPS-0699-132
R&P Partisol®-Plus Model 2025 FEM	$PM_{2.5}$	Manual Reference Method RFPS-1298-145

Continuous monitoring of the PM_{10} particle concentrations at both Launceston and Hobart have been performed using TEOMs fitted with a PM_{10} size selective inlet, in accordance with AS/NZS 3580.9.8:2008 (*Methods for sampling and analysis of ambient air – PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser*)

Where practicable, the daily average PM_{10} concentrations measured by an approved low volume air sampler were used for the purposes of determining compliance with the NEPM Standard. When LVAS data were not available, the daily average PM_{10} measurement from the TEOM was used, with the following empirical temperature adjustment developed for Tasmanian conditions.

Adjusted PM_{10} = Measured PM_{10} x Temperature Correction Factor [TCF]

Where TCF = 1.00 for 24 hr average temperature $[T_{24}] \geq 15°C$

= $1.00 + (15 - T_{24}) / 25$ $0°C < T_{24} < 15°C$

= 1.60 When $T_{24} \leq 0°C$

Note: This reflects a change from 2007 and earlier years where TCF was previously:

TCF = 1.00 for 24 hr average temperature $[T_{24}] \geq 15°C$

= $1.00 + (15 - T_{24}) / 15$ for $0°C < T_{24} < 15°C$ and

= 2.00 $T_{24} \leq 0$.

(See the 2008 Tasmanian Monitoring Report for a discussion of this issue.)

The uncertainties associated with the low-volume measurements (U95) are estimated to be 1.4 µg/m^3 at 25 µg/m^3 and 2.6 µg/m^3 at 50 µg/m^3. For the day-averaged TEOM PM_{10}, 95% of the measurements are within 6 µg/m^3 of the low-volume air sampler value for simultaneous observations.