Northern Territory Government

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Northern Territory Air Monitoring Report 2009

Compliance with the National Environment Protection (ambient air quality measure)

Background

Clause 18 of the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) requires jurisdictions to submit a report on their compliance with the AAQ NEPM for each calendar year. The content of the jurisdictional report is prescribed in clause 17 of the AAQ NEPM.

This NT report covers the performance evaluation and assessment under the AAQ NEPM for the calendar reporting year 2009. The report is based on Technical Paper No. 8 (Annual Reports) which details the format and data requirements of the Annual Report. It is a technical report to the National Environment Protection Council (NEPC) and supplements the annual summary report provided each year by each jurisdiction under the NEPC Act on the overall implementation process.

The report is divided into 4 sections:

Section A: Overview of the 2009 AAQ NEPM monitoring network and activities.
Section B: Assessment of compliance with the AAQ NEPM Standards and Goals.
Section C: Assessment of monitoring data against the standards.
Section D: Data analysis and trends.

This report is available on the NRETAS website at: http://www.nt.gov.au/nreta/environment/air/ and at the Australian Government Environment Protection and Heritage Council (EPHC) website at: http://www.ephc.gov.au/taxonomy/term/34

Section A – Overview of the 2009 AAQ NEPM monitoring network and activities

A.1 Monitoring Requirements

The results of campaign monitoring in 2000-2001 were used to assess the monitoring requirements for the Northern Territory using the screening criteria outlined in Technical Paper 4 (Screening Procedures). This monitoring identified particles from landscape fires affecting the Darwin region as the primary air pollutant of concern in the Northern Territory. Screening of the 2000-2001 data indicated that nitrogen oxides, sulfur dioxide, carbon monoxide, ozone and lead aerosols were not a cause for concern in the Darwin/Palmerston conurbation when assessed against the AAQ NEPM standards.

Since that time the population and industrial activity in Darwin has increased and it is appropriate to consider evaluation of these pollutants again. The Northern Territory Government committed funding in 2008-09 to the establishment and ongoing operation of a comprehensive air quality monitoring system for the Darwin region. The new air quality monitoring system will build on current monitoring for particles to other pollutants identified in the AAQ NEPM in a manner consistent with the technical requirements of the AAQ NEPM. As of mid 2010 two air quality monitoring stations have been fabricated and are expected to be in operation by late 2010.

A.2 Current Monitoring Stations

In the Darwin /Palmerston conurbation there is currently one monitoring station located at Charles Darwin University, Casuarina, Darwin (Figure 1) which is in the northern suburbs. The area is entirely residential excepting the University campus and the Darwin airport is located about 4 km away to the SSE.

The two instruments designated as one station do not meet a number of the siting compliance standards partly due to the location atop adjacent two story buildings. No wind data is collected at the site and the buildings with structures nearby are likely to create eddies and wind disturbance. Although the trees are below the height of the top of the buildings, they are growing and are in close proximity to the instruments.

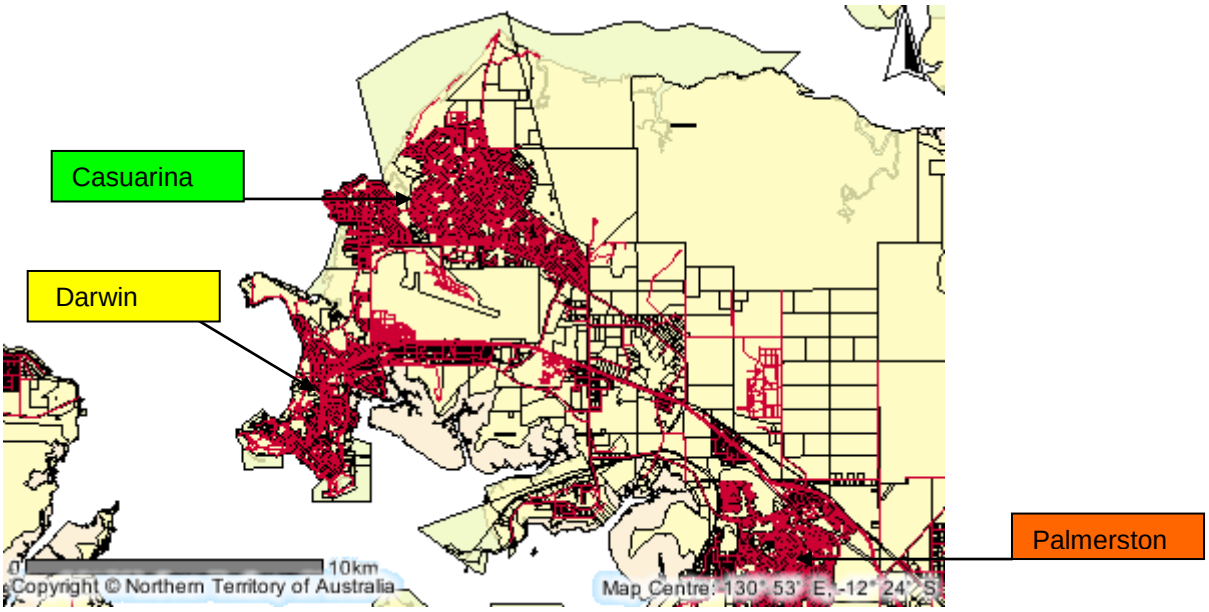

Figure 1: Darwin/Palmerston region showing location of Casuarina monitoring site

Table 1: Summary of station instrument siting compliance with AS 3580.1.1.2007

Station Instruments	Location Category	Height above ground	Clear Sky Angle	Unrestricted airflow of 270º/360º	20 m from trees	No boilers or incinerators nearby	Minimum distance from road or traffic
Casuarina TEOM	Residential / light industrial	No	Yes	Yes	No*	Yes	Yes
Casuarina Dichotomous Partisol	Residential / light industrial	No	Yes	Yes / No	No *	Yes	Yes

* Trees are within 20m but currently below the height of the buildings

A.3 Determination of Exposed Population for Each Performance Monitoring Station

Based on a total population for the Northern Territory of 225,900 (ABS June 2009) the Darwin/Palmerston conurbation (124,800) and Alice Springs (27,877) region are the only areas in the Northern Territory that exceed the population threshold for ambient air quality monitoring of >25,000.

The major air pollutant of concern for Darwin and Palmerston is particles from bushfire smoke in the Dry season (April - October). Prevailing winds during the Dry season are South-Easterly to Easterly, suggesting that population of the region may at times be exposed to particles from bushfires in surrounding areas. Monitoring at Palmerston in previous years has shown data consistency with the Casuarina

monitoring site. Monitoring for particles at Casuarina is expected to provide a representative measure of air quality experienced by the general population of the Darwin/ Palmerston region.

A.4 Monitoring during the Reporting Period

Sampling for particles was carried out during 2009 at the Casuarina monitoring station. Monitoring for PM_{10} was undertaken using both a Tapered Element Oscillating Microbalance (TEOM) sampler and Partisol Dichotomous sampler, with the latter also monitoring $PM_{2.5}$. Although Partisol dichotomous sampling is not a standard method for PM_{10} monitoring under NEPM technical guidelines, sampling has been maintained for PM_{10} to enable comparison and as a contingency to TEOM sampling. Data availability rates for both instruments were above 75% for each quarter as reported in Section B.

A.5 Changes to the Approved Monitoring Plan

As previously reported, data taken at both Casuarina and Palmerston had shown particulates consistency over a number of years to the extent that it was decided to rationalise monitoring to one site for the Darwin region. Under a Memorandum of Understanding between the Department of Natural Resources, Environment, the Arts and Sport (NRETAS) and Charles Darwin University (CDU), one monitoring station continues to be located in the Darwin region at the university campus, Casuarina. See Figure 5 which shows the two instruments 130 m apart atop two separate buildings.

The establishment of a new air quality monitoring system for the Darwin region in late 2010 will require the submission of a revised monitoring plan for approval of the Peer Review Committee (PRC). The currently proposed location for the primary long term trend station is at the Bureau of Meteorology site near the airport in Winnellie. A temporary second site near Palmerston has been proposed which will cover the Palmerston population and is also close to plumes modelled from existing and proposed industries on Middle Arm. Comparison of the two sites should confirm earlier work noting the similarity of particulates across the Darwin Air-shed and will provide new data for the AAQ NEPM gasses.

The need for monitoring in Alice Springs will continue to be considered, with the possibility that the temporary second station initially intended for Palmerston will be re-located to Alice Springs in the future.

A.6 Unresolved Issues

There are no other unresolved issues in the reporting period.

A.7 Status of NATA Accreditation

Current air quality monitoring at the CDU Darwin site is not NATA accredited. Quality controls are adopted as per manufacturers' specification and for laboratory gravimetric analysis. Weights are NATA accredited plus quality controls are adopted for calibration of the balance. NATA accreditation is a priority for the new Darwin air quality monitoring system.

A.8 Methods Other than Physical Monitoring

No other methods were used in the reporting period.

Section B – Assessment of compliance with AAQ NEPM standards and goals

PM_{10}

Table 2: 2009 annual compliance summary for 24 hr PM_{10}

AAQ NEPM Standard
50µg/m^3 (24-hour average)
Goal - no greater than 5 exceedences

Region/ Performance monitoring station	Data Availability Rates (% of Days)					Number of exceedences (days)	Performance against the standard and goal
	Q1	Q2	Q3	Q4	Annual		
Casuarina (TEOM)	96	96	96	96	96	9	Not Met *
Casuarina (Partisol)	94	88	96	94	93	9	Not Demonstrated #

* As discussed below, exceedences are attributed to local construction activities

\# Performance is not demonstrated as Partisol Dichotomous sampling is not a standard method for PM_{10} monitoring under the NEPM Technical Guidelines. Partisol data is presented as a comparison.

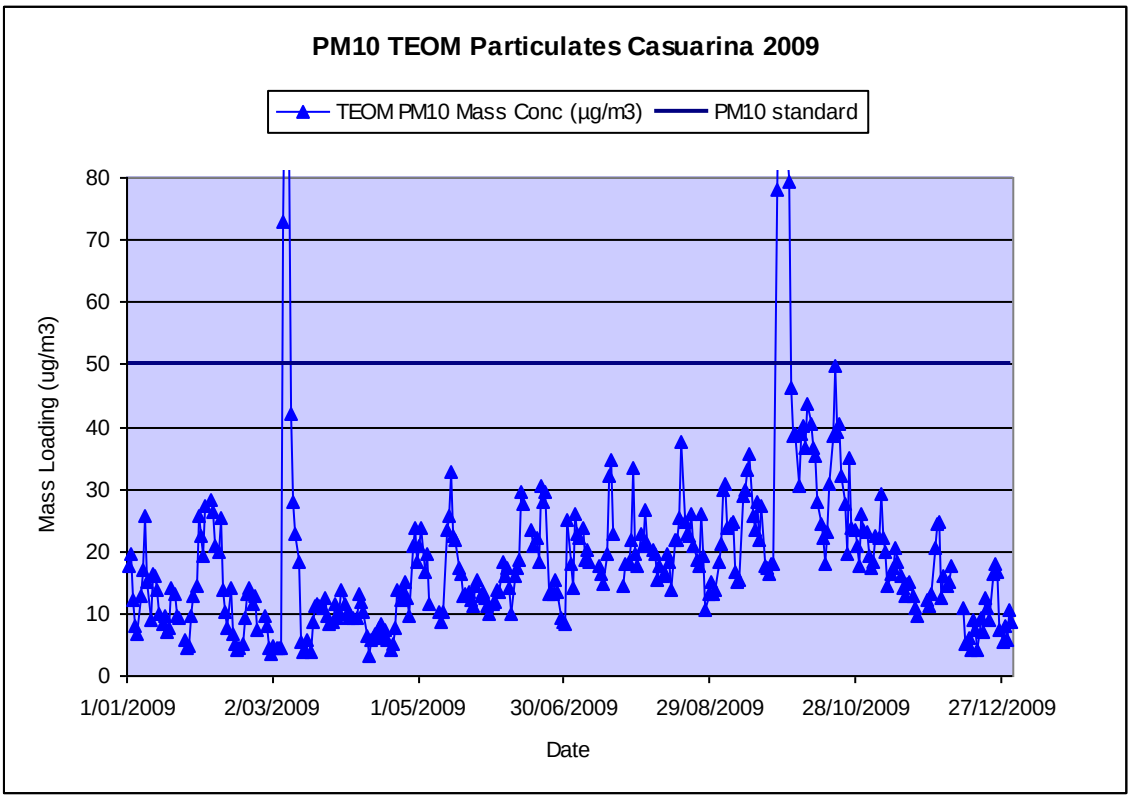

Figure 2: TEOM PM_{10} 24-hour mass loadings at Casuarina, Darwin 2009

Although the Lo-Vol Partisol Dichotomous sampler is not a prescribed instrument for PM_{10} measurements, historically good correlation with TEOM data at Casuarina suggests the data is valuable and is therefore provided in the current report. Figure 3 shows 2009 Partisol data that compares very closely with the TEOM data above.

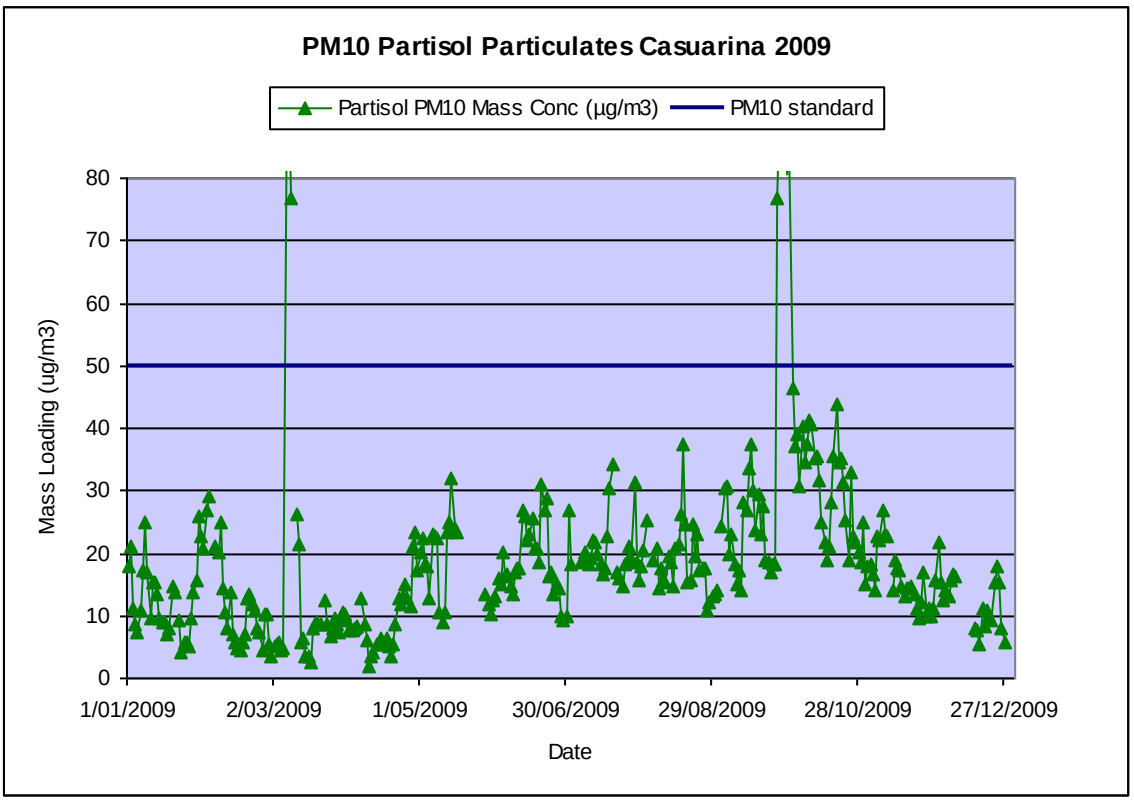

Figure 3: Partisol PM_{10} 24-hour mass loadings at Casuarina, Darwin 2009

$PM_{2.5}$

Table 3: 2009 annual compliance summary for 24 hr $PM_{2.5}$

AAQ NEPM Advisory Standard
25 µg/m^3 (24-hour average)
8 µg/m^3 (1-year average)

Region/ Performance monitoring station	Data Availability Rates (% of Days)					Number of exceedences (days)	Annual Mean
	Q1	Q2	Q3	Q4	Annual		
Casuarina (Partisol)	94	88	96	94	93	5	8.3

The data availability rates of the Partisol unit were significantly higher than the previous two years. The annual mean for 2009 is above the advisory reporting level of 8.0 and as explained below, this can be attributed to dust from construction activity during the year.

Figure 4 shows $PM_{2.5}$ with typical increase in levels during the dry season from May to November when most vegetation burning occurs.

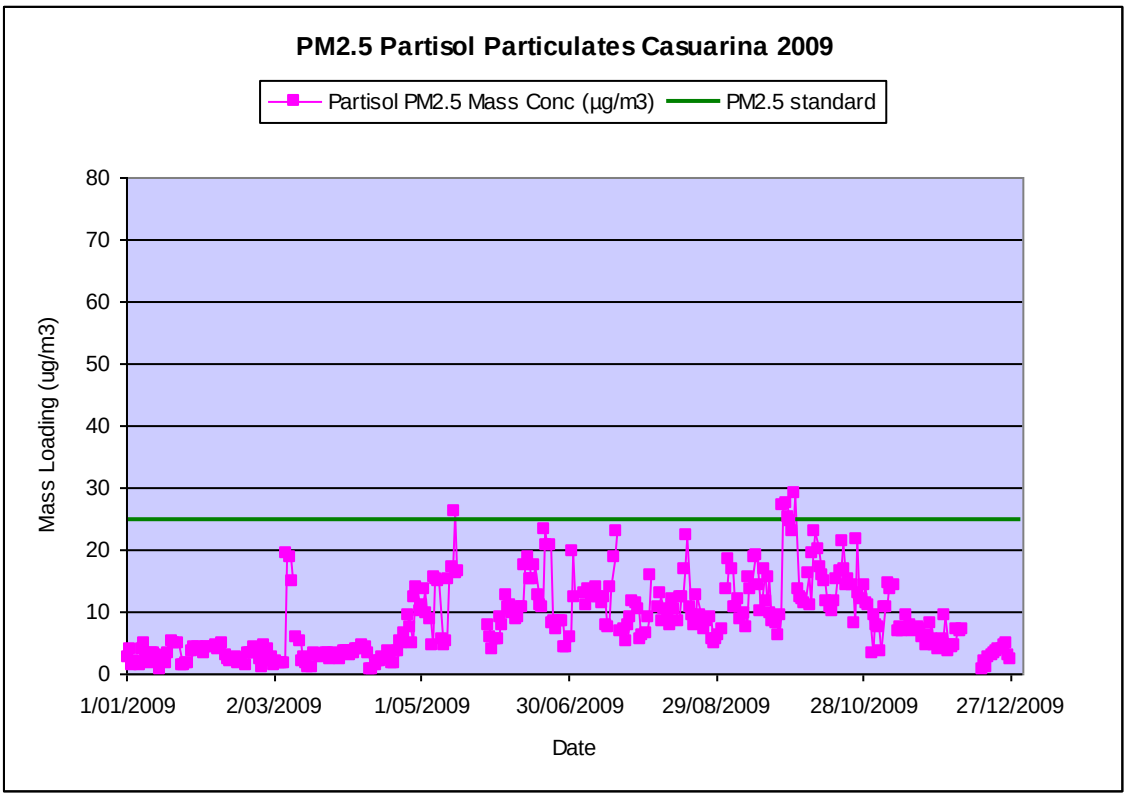

Figure 4: Partisol $PM_{2.5}$ 24-hour mass loadings at Casuarina, Darwin 2009

Section C – Assessment of air quality data against the standards

PM_{10}

In 2009, TEOM sampling at Casuarina recorded 9 exceedences of the AAQ NEPM standard for PM_{10} suggesting the AAQ NEPM standard has not been met. During several months of 2009 including March and September there were a series of construction events occurring in the area immediately adjacent to the stations that impacted local air quality, as further explained below.

In this 2009 report the Partisol data has been included in greater detail than previous years with the chart shown in Figure 3. Even though the Dichotomous Partisol unit is a Lo-Vol gravimetric sampler and as such is not the prescribed instrument under the PRC for measuring particulates, it has shown very good correlation with the TEOM over the past six years of data collection. This is supported by comparing Figures 2 and 3 above which show the 2009 PM_{10} for TEOM and Partisol.

Table 4: 2009 PM_{10} exceedences of NEPM reporting level at Casuarina monitoring station, Darwin (TEOM and Partisol sampling).

Date	TEOM PM_{10} mass ($\mu g/m^3$)	Partisol PM_{10} mass ($\mu g/m^3$)	Inferred Cause
6 Mar	*72.9*	4.8	Dust
7 Mar	*101.6*	*95.3*	Dust
8 Mar	*85.2*	*91.9*	Dust
9 Mar	42.2	*76.8*	Dust
25 Sep	*78.2*	*76.8*	Dust
26 Sep	*101.5*	*101.1*	Dust
27 Sep	*95.3*	*95.3*	Dust
28 Sep	*87.4*	*84.5*	Dust
29 Sep	*84.6*	*80.8*	Dust
30 Sep	*79.2*	*83.8*	Dust

Data not in italics is below reporting levels but is included for comparison.

It should be noted that the Partisol and TEOM instruments are located atop buildings about 130m apart (see Figure 5 below) thus the various construction works in the immediate area may at times affect one site and not the other. For example, on

6 March the 24 hour average Partisol PM_{10} was 4.8 µg/m^3 and for the same period the TEOM recorded 72.9 µg/m^3. Conversely, on 9 March the Partisol read 76.8 µg/m^3 while the TEOM read 42.2 µg/m^3 (see Table 4 above).

During the construction periods the Partisol filers occasionally showed an orange tinted dust consistent with the surface coating on a new temporary car-park (compare Figures 5 and 6 below). This dust is presumably associated with heavy vehicles active in the car-park and winds from that direction and was most noticeable on the filters on the dates highlighted in red in Table 3 above. The car-park and construction area was approximately 230 m to the WSW from the Partisol and 150m to the SSW of the TEOM instrument. Winds from the SW in general are not common in Darwin and this would help to explain why there were not more incidences of contamination. Unfortunately no wind direction data are available from the immediate area with the nearest at the Bureau of Meteorology some 6.2 km to the SSE. There are no suitable locations around Charles Darwin University Campus where wind data can be obtained in accordance with the Australian Standards. This is another issue which will be resolved with the location of a new station at the proposed at the Bureau of Meteorology site near the Airport.

The maximum previous peak 24 hour readings for PM_{10} particulates in Darwin since 2004 with both TEOM and Partisol instruments was less than 70µm/m^3 and all of the exceedences this year are above or well above 70µg/m^3. This reinforces the conclusion that the dust is a local phenomenon and does not accurately represent ambient air quality of the region. If the exceptionally high peaks that are recorded above are ignored, then there would be no PM_{10} exceedences recorded for the 2009 Calendar year. There was one exceedence recorded for $PM_{2.5}$ outside this period that cannot be attributed to construction works on 14 May, and is most likely the result of smoke from vegetation burning.

There are notable periods of elevated PM_{10} during the Wet season (January and February) when vegetation burning does not occur. This is consistent with periods of strong westerly winds that persist for several days and with the Casuarina instruments located just over 1 km from the beach it is likely that these particulates are sea salt. Literature review supports this view suggesting the particulates are associated with the coarse fraction and typically there are no noticeable increases during the same period on the PM_{10} chart (Figure 4).

Figure 5: Charles Darwin University Casuarina campus in the northern suburbs of Darwin taken prior to 2009 with the instruments located approximately 130m apart (Courtesy NRETAS Maps).

Figure 6: The same location as above but taken in 2010 showing the large building bottom left replaced by a smaller building and altered car park (Courtesy NRETAS maps).

Table 5: 2009 summary statistics for 24-hour TEOM and Partisol PM_{10} at Casuarina monitoring station

AAQ NEPM standard
50µg/m^3 (24-hour average)

	Number of valid days	Highest (µg/m^3)	Highest (date)	6th highest (µg/m^3)	6th highest (date)
TEOM	342	101.6	26 Sep	84.6	29 Sep
Partisol	329	101.1	26 Sep	79.2	30 Sep

In 2009, the highest readings for PM_{10} particulates for TEOM and Partisol instruments respectively occurred on the same day while the 6th highest readings were on adjacent days. All the PM_{10} exceedences occurred in the March or September construction and wind events with no exceedences at other times during 2009.

$PM_{2.5}$

Table 6: 2009 $PM_{2.5}$ exceedences of NEPM reporting level at Casuarina monitoring station, Darwin (Partisol sampling)

Date	$PM_{2.5}$ mass (µg/m^3)
14 May 2009	26.2
25 September 2009	27.1
26 September 2009	27.3
27 September 2009	25.2
30 September 2009	28.9

Four of the five exceedences for $PM_{2.5}$ occurred on the same days as the PM_{10} exceedences which correlate with the construction activities discussed above.

As noted in Table 3 the $PM_{2.5}$ annual mean of 8.3 µg/m^3 is above the advisory annual mean of 8.0 µg/m^3. If the ten days when PM_{10} levels at either or both PM_{10} instruments are discounted then the annual average is reduced to 8.0 µg/m^3.

Table 7: 2009 summary statistics for 24-hour Partisol $PM_{2.5}$ at Casuarina monitoring station

AAQ NEPM Advisory Standard
25µg/m^3 (24-hour average)

Number of valid days	Highest (µg/m^3)	Highest (date)	6th highest (µg/m^3)	6th highest (date)
329	28.9	30 Sep	24.4	28 Sep

The elevated levels of particles in Darwin during the Dry season are predominantly due to bushfire smoke. Whilst there is no other significant source of particles affecting the region apart from localised impacts from dust attributed to land clearing and urban development, the overriding influence on levels of PM_{10} and $PM_{2.5}$ against the AAQ NEPM national standard and reporting level respectively are almost certainly from the interaction of smoke from landscape fires in the region and the prevailing wind conditions (South-Easterly and Easterly during the Dry season).

Monitoring of particles will contribute towards development of NT Government air quality policy and provide the basis for the development of appropriate and effective management strategies aimed at ensuring the AAQ NEPM standards and goals will continue to be met in the future. The Northern Territories Territory 2030 Strategy establishes the target of continuing to meet or better national air quality standards across the Territory. NRETAS is continuing to discuss fire management in the region with the Northern Territory Bushfires Council in an ongoing process to minimise the impacts of particles from smoke on the Darwin region. This includes engagement in projects aimed at reducing greenhouse gas emissions from savannah fires.

No monitoring has been undertaken in Alice Springs and compliance with the AAQ NEPM has not been demonstrated.

Section D – Data analysis and trends

Table 8: Summary of daily peak percentiles concentration (µg/m^3) PM_{10} and $PM_{2.5}$, 2008

Pollutant	Data Availability (% of days)	Max. conc. µg/m^3	Percentiles µg/m^3					
			99th	98th	95th	90th	75th	50th
TEOM PM_{10}	93.7	101.6	86.5	78.4	38.9	30.7	22.7	16.2
Partisol PM_{10}	90.1	101.1	89.8	78.6	37.4	30.8	22.4	16.5
Partisol $PM_{2.5}$	90.1	28.9	25.9	23.1	19.5	16.4	11.9	7.2

It is not possible to accurately compare number of exceedences over time in accordance with AAQ NEPM technical requirements, as different sampling techniques have been used since monitoring began in 2004 (TEOM and Partisol). Specifically this is due to use of Partisol data instead of TEOM data for 2006 because of very low data availability. As an indication however, comparisons of exceedences for PM_{10} and $PM_{2.5}$ for the period 2004 – 2009 are presented in Figure 7.

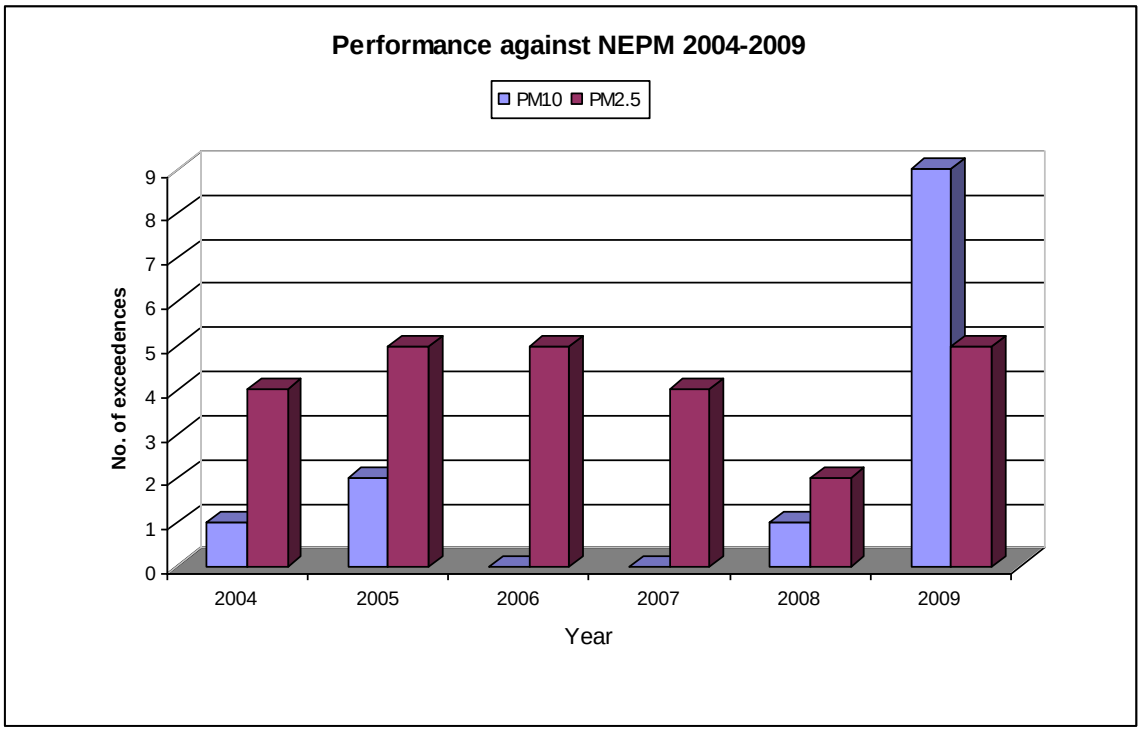

Figure 7: Comparison of Partisol PM_{10} and $PM_{2.5}$ exceedences at Casuarina, Darwin for the years 2004-2009.

If the exceedences attributed to the construction activity in the area during 2009 are removed, the chart of exceedences shows a decreasing trend over the previous 4 years (see Figure 8 below). It is an encouraging sign suggesting bushfire control in

the Northern Territory Top End may be having a positive impact on air quality in Darwin.

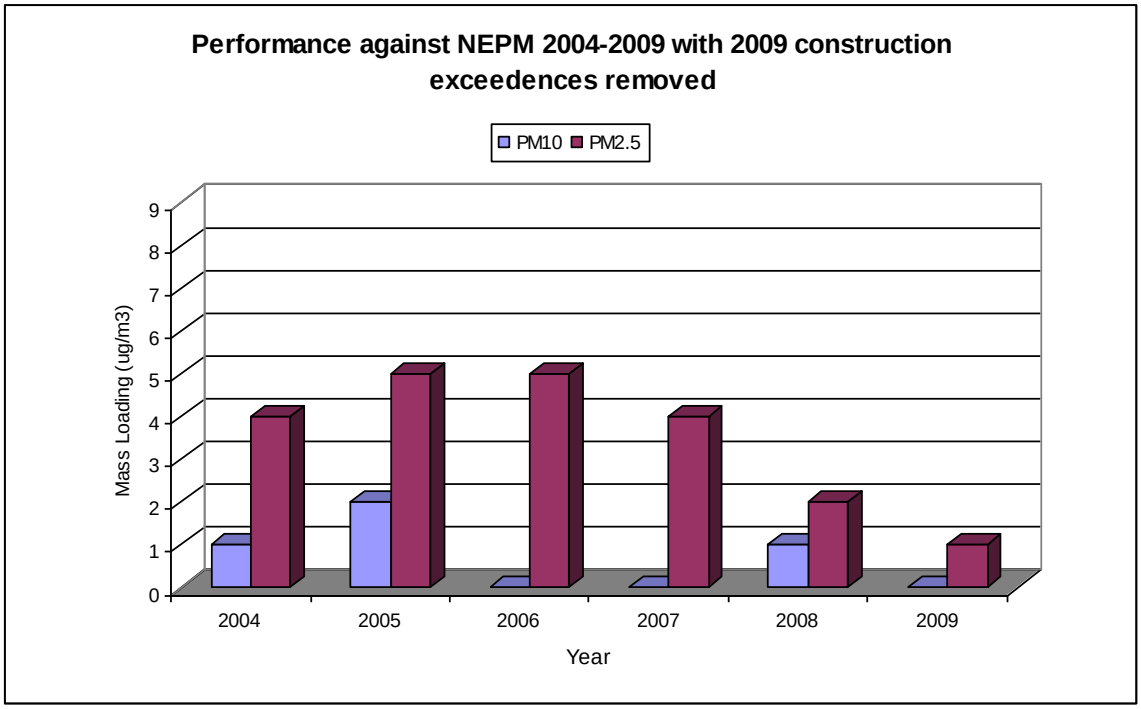

Figure 8: Comparison of Partisol PM_{10} and $PM_{2.5}$ exceedences at Casuarina, Darwin for the years 2004-2009 with the construction activity exceedences in 2009 removed.

Statistical trends for 2004-2008 are presented in Tables 8 and 9.

Table 9: Trends in percentiles of daily peak concentration (µg/m^3) PM_{10}, 2004-2008 (TEOM or dichotomous Partisol sampler for 2006)

AAQ NEPM standard
50µg/m^3 (24-hour average)

Year	Data Availability (% of days)	No. of exceedences (days)	Max. conc. µg/m^3	Percentiles µg/m^3					
				99th	98th	95th	90th	75th	50th
2004	*68.8*	*1*	*53.7*	*44.7*	*38.5*	*29.7*	*26.3*	*21.4*	*17.4*
2005	98.1	2	**63.4**	37.6	31.8	29.4	26.2	21.3	15.1
2006*	97.0	0	44.1	39.0	34.7	30.2	26.5	21.2	14.6
2007	95.1	0	45.3	38.5	32.4	28.2	24.3	19.0	12.2
2008	97.3	1	**64.8**	40.6	37.8	33.0	27.3	19.0	14.0
2009	93.7	9	**101.6**	**86.5**	**78.4**	38.9	30.7	22.7	16.2

* Partisol PM_{10} data used for this year due to very poor data recovery rate from TEOM PM_{10}

Years with data availability less than 75% shown in italics. Exceedences shown in bold. Note that data collection commenced in April 2004.

Table 10: Trends in percentiles of daily peak concentration (µg/m^3) $PM_{2.5}$, 2004-2008 (Partisol Dichotomous Sampler)

AAQ NEPM reporting level 25µg/m^3 (24-hour average)

Year	Data Availability (% of days)	No. of exceedences (days)	Max. conc. µg/m^3	Percentiles µg/m^3					
				99th	98th	95th	90th	75th	50th
2004	*60.1*	*4*	***36.5***	***26.7***	*24.8*	*20.8*	*17.7*	*13.9*	*9.5*
2005	97.8	5	**57.7**	**26.6**	22.6	17.6	15.2	11.1	6.8
2006	97.0	5	**29.9**	**25.9**	20.9	16.6	14.6	10.9	6.5
2007	*64.0*	*4*	***47.7***	***25.8***	*22.0*	*18.7*	*14.1*	*8.8*	*4.5*
2008	*71.1*	*2*	***31.5***	*24.5*	*22.2*	*17.9*	*15.1*	*10.7*	*7.0*
2009	90.1	5	**28.9**	**25.9**	23.1	19.5	16.4	11.9	7.2

Years with data availability less than 75% shown in italics. Exceedences shown in bold. Note that data collection commenced in April 2004.

References

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