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# Northern Territory Air Monitoring Report 2010

## 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 2010. 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 2010 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. Analysis 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 region 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 particulates to other pollutants identified in the AAQ NEPM in a manner consistent with the technical requirements of the AAQ NEPM. One of two stations was installed near Palmerston in November 2010 while the primary trend station is expected to be in operation by late 2011 at the Bureau of Meteorology Winnellie facility near the Darwin Airport. Results from the Palmerston station are not included in this report because the data collected was during commissioning and has not been validated. NATA accredited and validated data is being generated from this station as of 1 January 2011 and will be included in the next report.

## A.2 Current Monitoring Stations for the purposes of this report

In the Darwin /Palmerston conurbation there is currently one monitoring station located at Charles Darwin University, Casuarina, in the northern suburbs of Darwin (Figure 1). The area is entirely residential except for the University campus although the Darwin airport is located about 4 km 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 on the roof of 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, the original and new Palmerston and proposed Winnellie monitoring station sites.**


**Table 1: Summary of station instrument siting compliance with AS 580.1.1.2007**

| Station Instruments | Location Category | Height above ground | Clear Sky Angle | Unrestricted airflow of 270°/360° | 20 m from trees | No boilers or incinerators nearby | Minimum distance from road or traffic |
|---|---|---|---|---|---|---|---|
| Casuarina TEOM | Residential / light industrial | No | Yes | 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 and sample inlets

The new Palmerston station was installed in mid November 2010 and commissioned at the end of 2010. NATA validated and accredited data from this station

commencing Jan 1 2011 will be available for the next reporting period. The proposed Winnellie monitoring station is planned for installation in late 2011 and like the Palmerston station will have instruments to analyse CO, $NO_2$, $O_3$, $SO_2$ and dichotomous TEOM to analyse $PM_{10}$ and $PM_{2.5}$.

### 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 region (124,760) and Alice Springs (27,895) region are the only areas in the Northern Territory that exceed the population threshold for ambient air quality monitoring of greater than 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 the population of the region are frequently exposed to particles from bushfires in surrounding and more distant areas. Monitoring at the original Palmerston site 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 2010 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 the NEPM, it is a USEPA reference method. Sampling has been maintained for Partisol $PM_{10}$ to enable comparison and as a contingency to TEOM sampling. Data capture rates for the TEOM were below 75% for the 3$^{rd}$ quarter and for the Partisol during the 1$^{st}$ and 4$^{th}$ quarters.

### A.5 Changes to the Approved Monitoring Plan

Under a Memorandum of Understanding between the Department of Natural Resources, Environment, the Arts and Sport (NRETAS) and Charles Darwin University (CDU), a monitoring station continues to be operated in the Darwin region at the university campus, Casuarina.

A new MoU with CDU has accompanied the establishment of a new air quality monitoring network for the Darwin region. The proposed location for the primary long term performance trend monitoring station is at the Bureau of Meteorology site near the airport in Winnellie. A second campaign monitoring station near Palmerston was installed in late 2010 which covers the Palmerston population and is also close to plumes modelled from existing and proposed industries on Middle Arm. Comparison of data from 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 now located in Palmerston will be re-located to Alice Springs in the future. The urgency of a full AAQ NEPM monitoring station in Alice Springs is less urgent due the expansion of the natural gas network to more houses allowing for the replacement of wood heaters which are traditionally a high source of particulates in winter.

### A.6 Unresolved Issues

There are no other unresolved issues in the reporting period.

### A.7 Status of NATA Accreditation

Current air quality monitoring for particulates at the CDU Casuarina 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 and data for the next reporting period is already NATA validated and accredited.

### 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

## Particulates $PM_{10}$

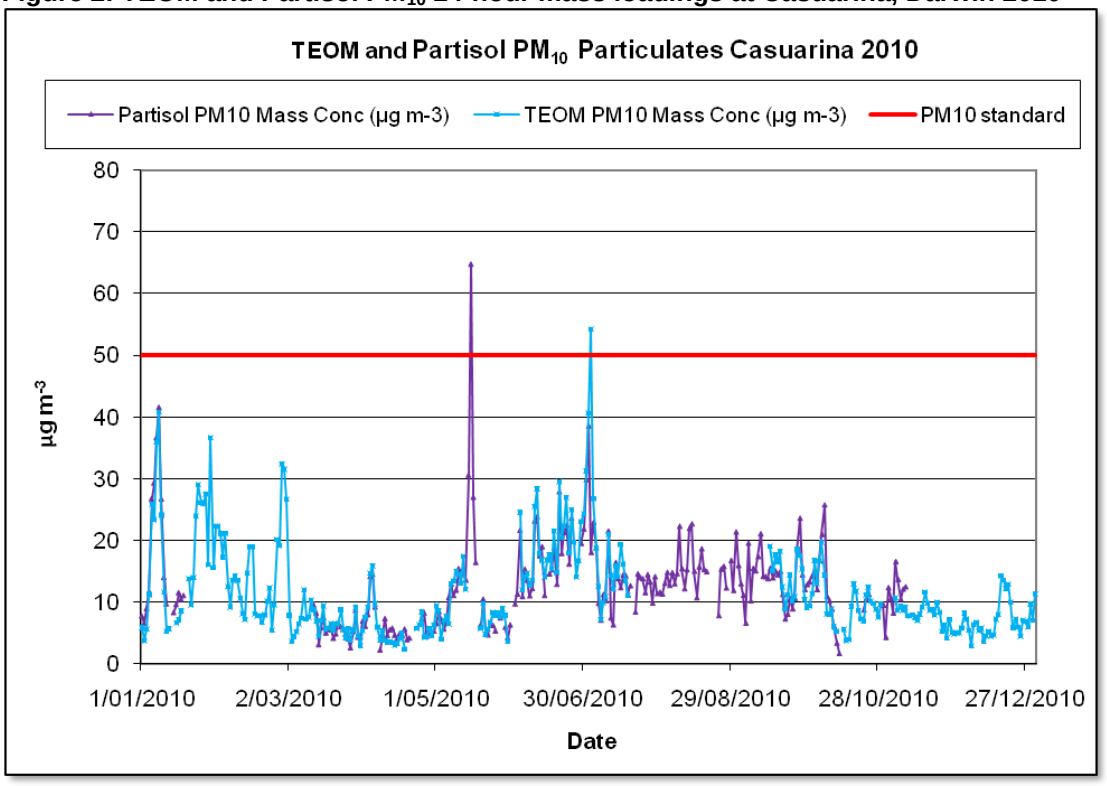
**Table 2: 2010 annual compliance summary for 24 hr $PM_{10}$**

AAQ NEPM Standard
50 µg $m^{-3}$ (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 | 86 | 38 | 92 | 78 | 1 | Not Demonstrated # |
| Casuarina (Partisol) | 40 | 86 | 94 | 27 | 62 | 1 | Not Demonstrated # |

# Performance is not demonstrated as Partisol Dichotomous sampling is not a standard method for $PM_{10}$ monitoring under the NEPM Technical Guidelines and the 3rd quarter for TEOM and 1st and 4th quarters for Partisol had data capture rates below 75%.

**Figure 2: TEOM and Partisol $PM_{10}$ 24-hour mass loadings at Casuarina, Darwin 2010**




Although the Lo-Vol Partisol Dichotomous sampler is not a designated Australian Standard 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. Note that the significant gaps in the data from one instrument are fortuitously filled by the other providing reasonably consistent coverage of $PM_{10}$ for the year (see Figure 2). The significant mid-year peaks are associated with vegetation burning soon after the end of the dry season and the peaks during

January and February are associated with periods of strong westerly winds carrying sea salt to the instruments.

## Particulates $PM_{2.5}$

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

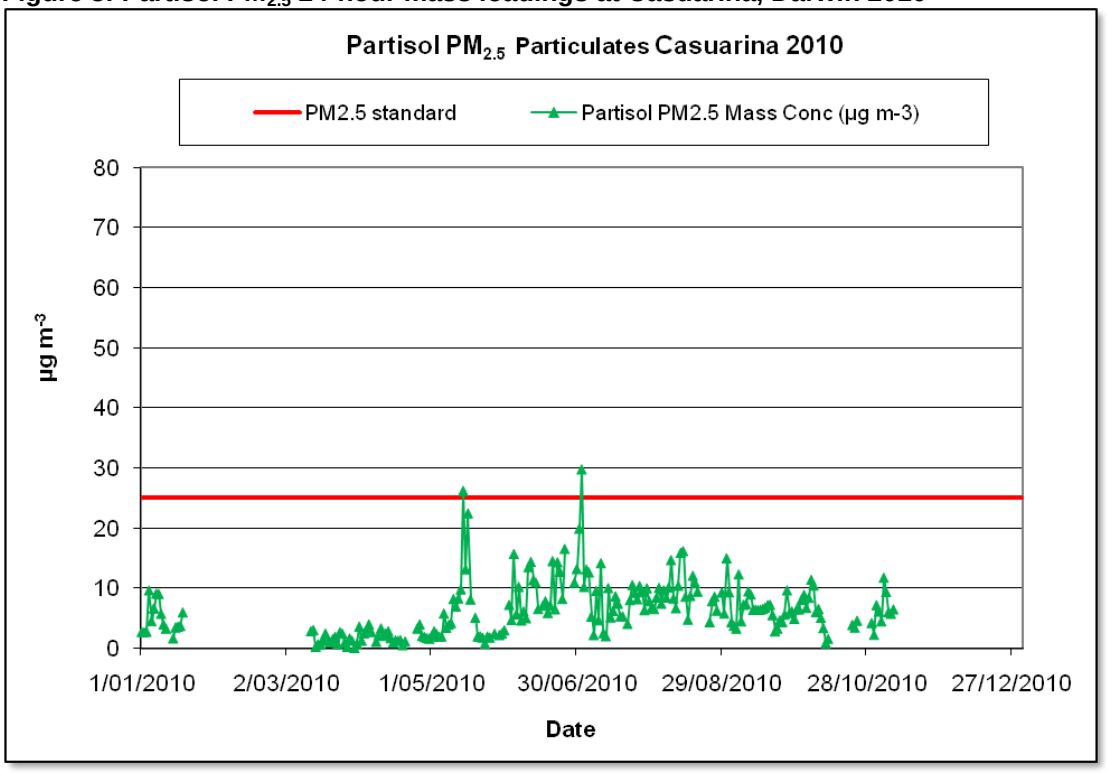
AAQ NEPM Advisory Standard
25 µg $m^{-3}$ (24-hour average)
8 µg $m^{-3}$ (1-year average)

| Region/ Performance monitoring station | Data Availability Rates (% of Days) | | | | | Number of exceedences (days) | Annual Mean |
|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Annual | | |
| Casuarina (Partisol) | 40 | 86 | 94 | 27 | 62 | 2* | 6.3# |

* Achieving the advisory standard was not demonstrated because the data availability rates were below 75% for the 1st and 4th quarters.
#The annual mean cannot be considered to be representative due to the low data capture rates.

The data availability rates of the Partisol unit were very low for 2010 and the annual mean of 6.3 is below the advisory reporting level of 8.0. Typically the $PM_{2.5}$ data is influenced most significantly by smoke during the dry season thus the low value based mostly dry season data is unexpected and not typical.

**Figure 3: Partisol $PM_{2.5}$ 24-hour mass loadings at Casuarina, Darwin 2010**



# Section C – Assessment of air quality data against the standards

### Particulates $PM_{10}$

In 2010, TEOM sampling at Casuarina recorded 1 exceedence of the AAQ NEPM standard for $PM_{10}$ while there was also one exceedence recorded on the Partisol but with less than 75% data capture on the TEOM for the third quarter compliance is not demonstrated.

As described in the previous report the Partisol has shown very good correlation with the TEOM over the past seven years of data collection. Since the gaps in the data for PM10 are substantially covered by the other instrument then the exceedences as recorded can be assumed to be a good indication.

**Table 4: 2010 $PM_{10}$ exceedences of NEPM reporting level at Casuarina monitoring station, Darwin (TEOM and Partisol sampling).**

| Date | TEOM $PM_{10}$ mass (µg $m^{-3}$) | Partisol $PM_{10}$ mass (µg $m^{-3}$) | Inferred Cause |
|---|---|---|---|
| 15 May | NA | *64.8* | Smoke |
| 3 July | *54.2* | 18.1 | Smoke |

Data not italicized is below reporting levels but is included for comparison.

It should be noted that the Partisol and TEOM instruments are located on top of buildings about 130m apart and activities in the immediate area may at times affect one site and not the other. For example, on 3 July the daily difference between the two instruments was 36.1 µg $m^{-3}$. In the reporting year 2009 there were periods of severe exceedences associated with construction activity to the South West of the stations. That activity ceased before 2010 so the discrepancy for 3 July is unexplained although a smoke event could have been in the immediate area and the resulting plume affected only on station. The number of exceedences is typical of the previous 6 years of data.

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 $PM_{2.5}$ chart (Figure 3).

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

AAQ NEPM standard
50 µg $m^{-3}$ (24-hour average)

| | Number of valid days | Highest (µg $m^{-3}$) | Highest (date) | 6th highest (µg $m^{-3}$) | 6th highest (date) |
|---|---|---|---|---|---|
| TEOM | 284 | 54.2 | 3 July | 32.4 | 27 Feb |
| Partisol | 225 | 64.8 | 15 May | 29.9 | 1 Jul |

In 2010, the highest and sixth highest $PM_{10}$ particulates readings for TEOM and Partisol instruments occurred on different days. All are typical of early dry season vegetation burning except the February event which is associated with sea salt.

## Particulates $PM_{2.5}$

**Table 6: 2010 $PM_{2.5}$ advisory exceedences of NEPM reporting level at Casuarina monitoring station, Darwin (Partisol sampling)**

| Date | $PM_{2.5}$ mass (µg $m^{-3}$) |
|---|---|
| 2 Jul | 29.9 |
| 14 May | 26.3 |

As noted above, the $PM_{2.5}$ annual mean of 6.3 µg $m^{-3}$ is below the advisory annual mean of 8.0 µg $m^{-3}$ but is not a valid number due to the low data capture rate of the Partisol instrument. Surprisingly most of the missing data is in the wet season which is typically represented by lower average $PM_{2.5}$ levels compared to the dry season thus the 2010 average could be considered better than expected.

**Table 7: 2010 summary statistics for 24-hour Partisol $PM_{2.5}$ at Casuarina monitoring station**

AAQ NEPM Advisory Standard
25 µg $m^{-3}$ (24-hour average)

| Number of valid days | Highest (µg $m^{-3}$) | Highest (date) | 6th highest (µg $m^{-3}$) | 6th highest (date) |
|---|---|---|---|---|
| 225 | 29.9 | 2 Jul | 16.3 | 13 Aug |

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 associated with 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 which are 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 $PM_{2.5}$, 2010**

| Instrument/ Pollutant | Data Availability (% of days) | Max. conc. µg $m^{-3}$ | Percentiles µg $m^{-3}$ | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 99th | 98th | 95th | 90th | 75th | 50th |
| TEOM $PM_{10}$ | 77.8 | 54.2 | 37.3 | 31.8 | 26.5 | 22.0 | 14.5 | 9.1 |
| Partisol $PM_{10}$ | 61.6 | 64.8 | 38.1 | 30.2 | 25.4 | 21.6 | 15.3 | 11.6 |
| Partisol $PM_{2.5}$ | 61.6 | 29.9 | 21.9 | 16.4 | 14.4 | 11.7 | 8.7 | 5.8 |

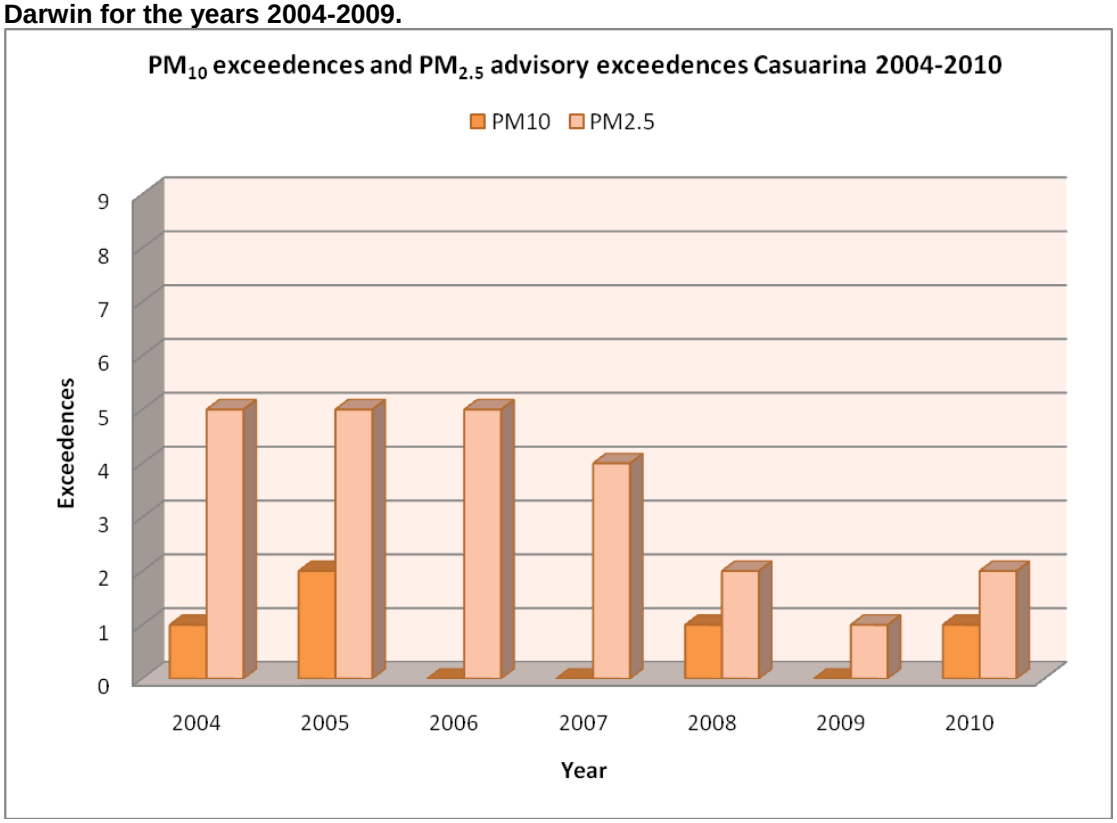
A comparison with the previous annual reports suggests that this year the particulates levels and medians were lower (see also table 9). It should be recognized the data capture rate is so low for 2010 that any comparison is fraught.

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) and instruments were locate at different station locations. Where possible, TEOM data is used for $PM_{10}$ and Partisol data for $PM_{2.5}$ but anomalies include the following:

- 2004 where data collection for this project did not commence until the second quarter.
- 2004 and 2005 where the TEOM was located in Palmerston at the Charles Darwin University Palmerston campus.
- 2006 where TEOM data unavailability was below 75% for each quarter so Partisol data was used.
- 2009 where exceedences due to construction activity if not ignored would show $PM_{10}$ at 9 and $PM_{2.5}$ at 5 exceedences. The dust produced from local activity and associated exceedences were not representative of the air in Casuarina and have been removed.
- 2010 where there is significant downtime especially with the Partisol and also TEOM instruments.

As an indication however, comparisons of exceedences for $PM_{10}$ and $PM_{2.5}$ for the period 2004 – 2010 are presented in Figure 7 with the 2009 construction exceedences marked as invalid and not shown. The chart of exceedences appears to show a slight downward trend in $PM_{2.5}$ over the previous 5 years. 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 7: Comparison of Partisol $PM_{10}$ and $PM_{2.5}$ advisory exceedences at Casuarina, Darwin for the years 2004-2009.**




An error in previous reports showed the number of PM2.5 exceedences in 2004 as 4.
The 2004 and 2005 TEOM $PM_{10}$ data is from the Palmerston campus of Charles Darwin University.
Numerous exceedences in 2009 due to local construction activity have been removed.

Statistical trends for 2004-2010 are presented in Tables 9 and 10.

**Table 9: Trends in percentiles of daily peak concentration (µg $m^{-3}$) $PM_{10}$, 2004-2010 (TEOM or dichotomous Partisol sampler for 2006)**

AAQ NEPM standard
50 µg $m^{-3}$ (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* | *68.9%* | *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 | 90.1% | 0 | 49.9 | 40.5 | 39.0 | 35.0 | 28.5 | 22.2 | 15.5 |
| 2010 | 77.8% | 1 | **54.2** | 37.3 | 31.8 | 26.5 | 22.0 | 14.5 | 9.1 |

Note that data collection commenced in April 2004
Partisol $PM_{10}$ data used for 2006 due to very poor data availability from TEOM $PM_{10}$
Years with data availability less than 75% shown in italics
Exceedences shown in bold

**Table 10: Trends in percentiles of daily peak concentration (µg $m^{-3}$) $PM_{2.5}$, 2004-2010 (Partisol Dichotomous Sampler)**

AAQ NEPM reporting level

| 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%* | *5* | ***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* | *67.7%* | *4* | ***47.7*** | ***25.8*** | *22.0* | *18.7* | *14.1* | *8.8* | *4.5* |
| *2008* | *71.6%* | *2* | ***31.5*** | *24.5* | *22.2* | *17.9* | *15.1* | *10.7* | *7.0* |
| 2009 | 86.8% | 1 | **26.2** | 22.7 | 21.2 | 18.5 | 15.4 | 11.5 | 7.1 |
| *2010* | *61.6%* | *2* | ***29.9*** | *21.9* | *16.4* | *14.4* | *11.7* | *8.7* | *5.8* |

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

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