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**TRANSFIELD SERVICES PTY. LTD.,  
RINGWOOD, VICTORIA**

# **EastLink Ambient Air Quality Monitoring Report April-June 2009**

**Submitted to:**  
Transfield Services Pty. Ltd.

REPORT



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### APPENDICES

#### APPENDIX A

Limitations



## **1.0 INTRODUCTION**

EastLink is a 39-kilometre motorway running between Donvale in Melbourne's north east to Frankston in Melbourne's south east with two tunnels under the Mullum Mullum Valley. Transfield Services, who are responsible for operation and maintenance of the road, commissioned Golder Associates Pty. Ltd. {trading as A.W.N. (Air Water Noise) Consultants} to provide ambient air quality monitoring services for the EastLink Road project. The services provided include:

- Operational and maintenance services of the EastLink ambient air monitoring stations; and
- NATA endorsed ambient air quality monitoring reports

Monitoring commenced on the 29th June 2008 with the opening of the EastLink motorway. Results for the monitoring period 1st April, 2009 to 30<sup>th</sup> June, 2009 inclusive are contained in the following report.

Your attention is drawn to the document - "Limitations", which is included in Attachment A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.



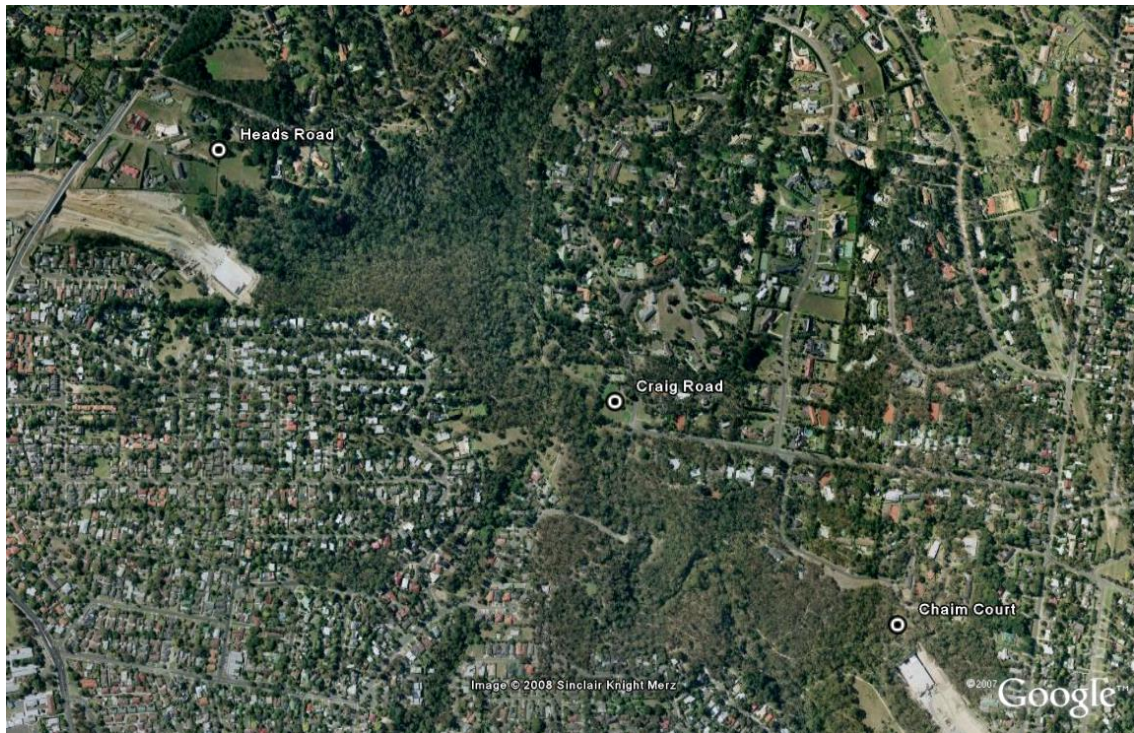


## 2.0 MONITORING LOCATIONS

Three ambient air quality monitoring stations (AAQMS) are located along the Mullum Mullum valley in close proximity to the tunnel portals and ventilation stacks. The locations are described in Table 1 and depicted in Figure 1.

**Table 1: Site Locations**

STATION NAME	LOCATION	GPS CO-ORDINATES (AMG)
Chaim Court	Chaim Court, Donvale	342532E, 5814022S
Craig Road	Corner Craig Rd. and Beckett Rd. Donvale	341971E, 5814450S
Heads Road	Hillcrest Reserve, Heads Road, Donvale	341195E, 5814923S



*Figure 1: Ambient Air Monitoring Stations*



### **3.0 AMBIENT AIR QUALITY MONITORING PARAMETERS**

The following ambient air quality parameters are monitored continuously and averages logged at 5 minute intervals.

- Particulate matter with an equivalent aerodynamic diameter less than 2.5 microns (PM<sub>2.5</sub>);
- Particulate matter with an equivalent aerodynamic diameter less than 10 microns (PM<sub>10</sub>);
- Total oxides of nitrogen (NO<sub>x</sub>);
- Nitric oxide (NO);
- Nitrogen dioxide (NO<sub>2</sub>);
- Carbon monoxide (CO);
- Wind speed;
- Wind direction;
- Relative humidity;
- Ambient temperature and
- Total solar radiation.



## **4.0 METHODS**

### **4.1 PM<sub>2.5</sub>**

PM<sub>2.5</sub> concentration in ambient air was determined in real time using a Tapered Element Oscillating Microbalance (TEOM) analyser fitted with the Flow Dynamics Measurement System (TEOM-FDMS).

Ambient air was drawn through a PM<sub>2.5</sub> size selective inlet (PM<sub>10</sub> WINS head fitted with a PM<sub>2.5</sub> sharp cut cyclone (SSC)) at 1 m<sup>3</sup>/h. The PM<sub>2.5</sub> fraction passed through the FDMS unit which compensates for loss of volatile material from the TEOM filter. Measurements were made in real-time (2 s intervals) with the 5-minute averages logged. 1-hour and 24-hour averages were then calculated from the logged data.

### **4.2 PM<sub>10</sub>**

PM<sub>10</sub> concentration in ambient air was determined in real time using a Tapered Element Oscillating Microbalance (TEOM) analyser. Ambient air was drawn through a PM<sub>10</sub> WINS size selective inlet at 1 m<sup>3</sup>/h. Measurements were made in real-time (2 s intervals) with the 5-minute averages logged. From the logged data 1-hour and 24-hour averages were then calculated.

The sample stream is heated to 50°C to maintain a low and therefore relatively constant humidity.

PM<sub>10</sub> monitoring was conducted in accordance with Australian Standard AS 3580.9.8, "Methods for Sampling and Analysis of Ambient Air: Determination of Suspended Particulate Matter – PM<sub>10</sub> Continuous Direct Mass Method Using a Tapered Element Oscillating Microbalance Analyser".

### **4.3 Carbon Monoxide**

Carbon monoxide monitoring was conducted in accordance with Australian Standard AS 3580.7.1-1992, "Determination of Carbon Monoxide – Direct Reading Instrumental Method".

### **4.4 Oxides of Nitrogen**

Oxides of nitrogen (NO, NO<sub>2</sub> and NO<sub>x</sub>) monitoring was conducted in accordance with Australian Standard AS 3580.5.1-1993, "Determination of Oxides of Nitrogen – Chemiluminescence Method".

## **4.5 Meteorological Parameters**

### **4.5.1 Wind Speed and Direction**

Wind speed and direction was measured by ultrasonic anemometer located 10 m above ground level.

### **4.5.2 Temperature and Relative Humidity**

Temperature and relative humidity were measured by combined temperature- humidity sensor.

The sensors comprise a platinum resistance thermometer (PRT) to measure temperature and a capacitive thin-film polymer sensor to measure humidity.



## 5.0 AIR QUALITY GOALS

The Environment Protection Act of 1970 provides a legislative framework for the protection of the environment in Victoria. Section 16(1) details the provision for environment protection policies to stipulate environment protection for any element or segment of the environment. The State Environment Protection Policy (Air Quality Management) {SEPP (AQM)} is relevant to the ambient air quality objectives of the EastLink monitoring programme.

The intention of the SEPP (AQM) is to manage emissions to the air environment so that “beneficial uses of the air environment are protected, Victoria’s air quality goals and objectives are met”, with an overall emphasis on continual improvement, with regard to the economic and social development of the State.

The SEPP (AQM) provides the framework for this objective through the classification of air quality indicators and the stipulation of management strategies and criteria. Applicable to the EastLink ambient monitoring programme are the assessment criteria for local or neighbourhood air monitoring data contained within Schedule B. The criteria are listed as intervention levels which are used to determine whether the beneficial uses of the air environment are protected.

The Schedule B intervention levels for Class 1 indicators, carbon monoxide, nitrogen dioxide and PM<sub>10</sub> and Class 2 indicator, PM<sub>2.5</sub>, are displayed in Table 2.

**Table 2: SEPP (AQM) Schedule B Intervention Levels**

ATMOSPHERIC CONTAMINANT		INTERVENTION LEVEL	UNITS
Carbon monoxide	1 hour	29	ppm
Nitrogen dioxide	1 hour	140	ppb
PM <sub>10</sub>	24 hour	60	µg/m <sup>3</sup>
PM <sub>2.5</sub>	24 hour	36	µg/m <sup>3</sup>



## 6.0 AMBIENT AIR QUALITY MONITORING PERIOD: 01/04/2009 – 30/04/2009

### 6.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance procedures.

The data capture statistics for the reporting period 1<sup>st</sup> April to 30<sup>th</sup> April, 2009 are shown in Tables 3-5. Averages were only collected for those periods where the 5-minute data constituted 75% data capture.

Section 6.3 provides further information on the reasons for invalid data periods.

**Table 3: Data Capture Statistics - 1 Hour Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM <sub>2.5</sub>	Chaim Crt.	719	720	99.9%
PM <sub>10</sub>	Chaim Crt	719	720	99.9%
	Craig Rd.	718	720	99.7%
	Heads Rd.	691	720	96.0%
NO, NO <sub>2</sub>	Chaim Crt	689	720	95.7%
	Craig Rd.	689	720	95.7%
	Heads Rd.	666	720	92.5%
CO	Chaim Crt	688	720	95.6%
	Craig Rd.	689	720	95.7%
	Heads Rd.	666	720	92.5%

**Table 4: Data Capture Statistics - 8 Hour Rolling Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
CO	Chaim Crt	720	720	100.0%
	Craig Rd.	720	720	100.0%
	Heads Rd.	694	720	96.4%

**Table 5: Data Capture Statistics - 24 Hour Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM <sub>2.5</sub>	Chaim Crt.	30	30	100.0%
PM <sub>10</sub>	Chaim Crt	30	30	100.0%
	Craig Rd.	30	30	100.0%
	Heads Rd.	28	30	93.3%



## 6.2 Results

### 6.2.1 PM<sub>2.5</sub>

PM<sub>2.5</sub> was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour and 24-hour averages for reporting.

PM<sub>2.5</sub> (1-hour average) concentration statistics for the reporting period are given in Table 6. A plot of PM<sub>2.5</sub> (1-hour average) concentration for the reporting period is presented in Figure 2.

**Table 6: PM<sub>2.5</sub> Concentration Percentiles (1 Hour Average)**

Station	PM <sub>2.5</sub> Concentration (µg/m <sup>3</sup> ) (1-hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	120	85	57	31	26	17	11

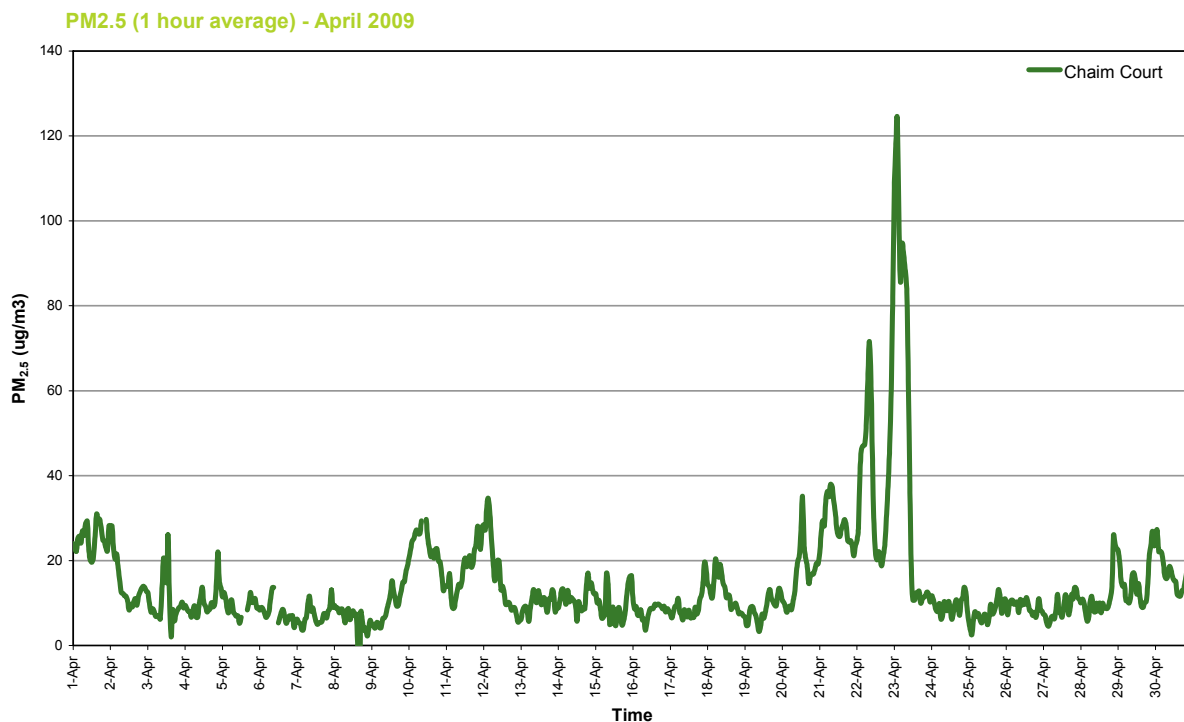


Figure 2: PM<sub>2.5</sub> Concentration (1 Hour Average)



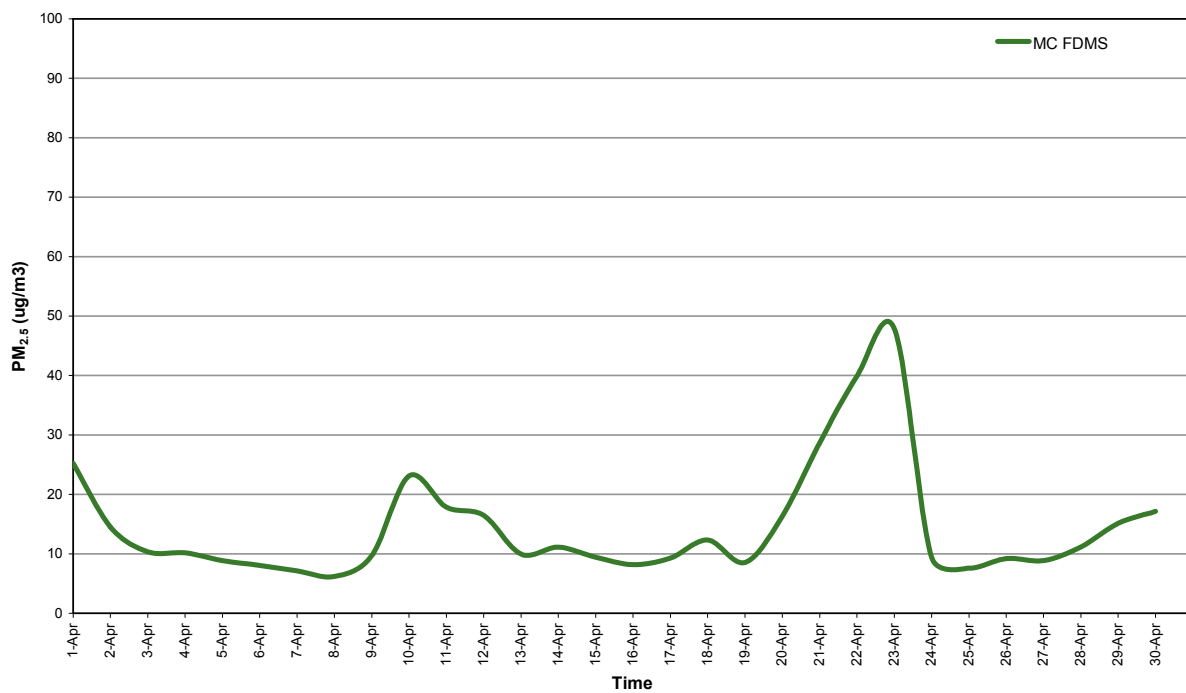


# EASTLINK AMBIENT AIR QUALITY MONITORING REPORT: APRIL-JUNE 2009

PM<sub>2.5</sub> (24-hour average) concentration statistics for the reporting period are given in Table 7. A plot of PM<sub>2.5</sub> (24-hour average) concentration for the reporting period is presented in Figure 3.

**Table 7: PM<sub>2.5</sub> Concentration Percentiles (24 Hour Average)**

Station	PM <sub>2.5</sub> Concentration (µg/m <sup>3</sup> ) (24-hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	48	46	43	35	26	16	10



*Figure 3: PM<sub>2.5</sub> Concentration (24 Hour Average)*



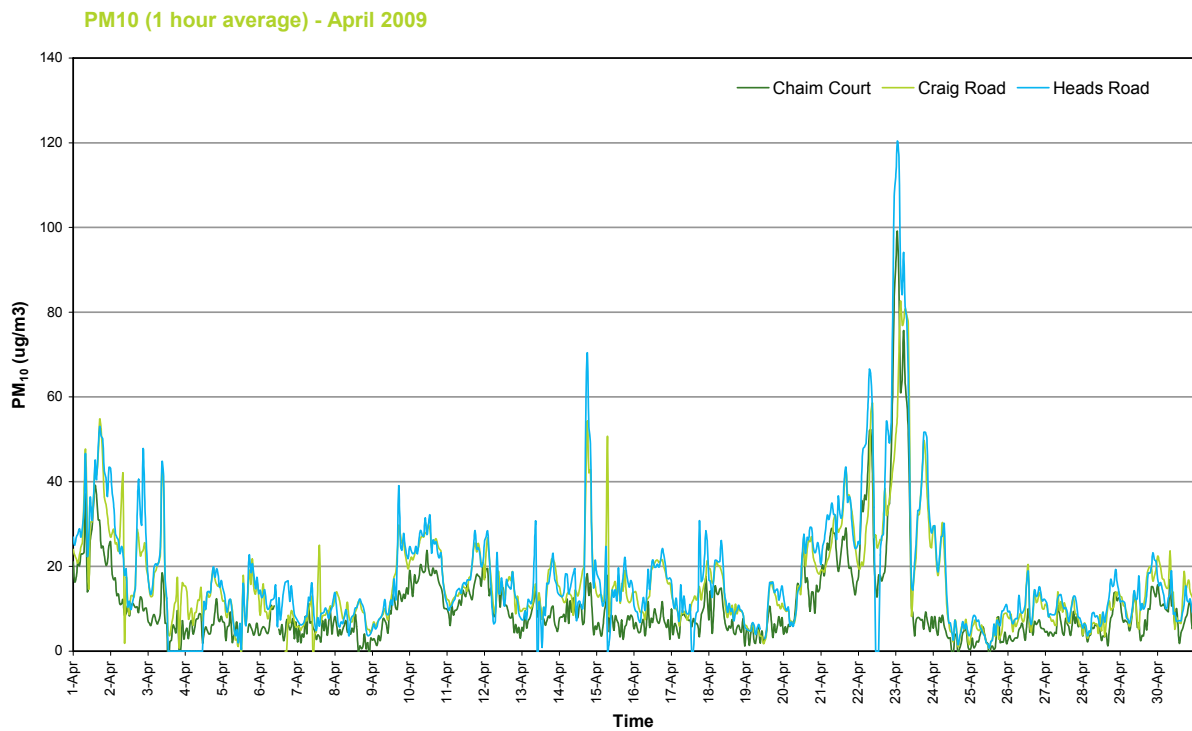
**6.2.2 PM<sub>10</sub>**

PM<sub>10</sub> was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour and 24-hour averages for reporting.

PM<sub>10</sub> (1-hour average) concentration statistics for the reporting period are given in Table 8. A plot of PM<sub>10</sub> (1-hour average) concentration for the reporting period is presented in Figure 4.

**Table 8: PM<sub>10</sub> Concentration Percentiles (1 Hour Average)**

Station	PM <sub>10</sub> Concentration (µg/m <sup>3</sup> ) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	99	62	42	26	19	13	7.4
Craig Rd	83	58	50	38	29	20	13
Heads Rd	120	82	60	46	33	23	14



*Figure 4: PM<sub>10</sub> Concentration (1 Hour Average)*





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PM<sub>10</sub> (24-hour average) concentration statistics for the reporting period are given in Table 9. A plot of PM<sub>10</sub> (24-hour average) concentration for the reporting period is presented in Figure 5.

**Table 9: PM<sub>10</sub> Concentration Percentiles (24 Hour Average)**

Station	PM <sub>10</sub> Concentration (µg/m <sup>3</sup> ) (24-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	33	33	33	29	22	12	7.9
Craig Rd.	47	43	39	33	29	17	14
Heads Rd	56	54	52	44	33	19	14

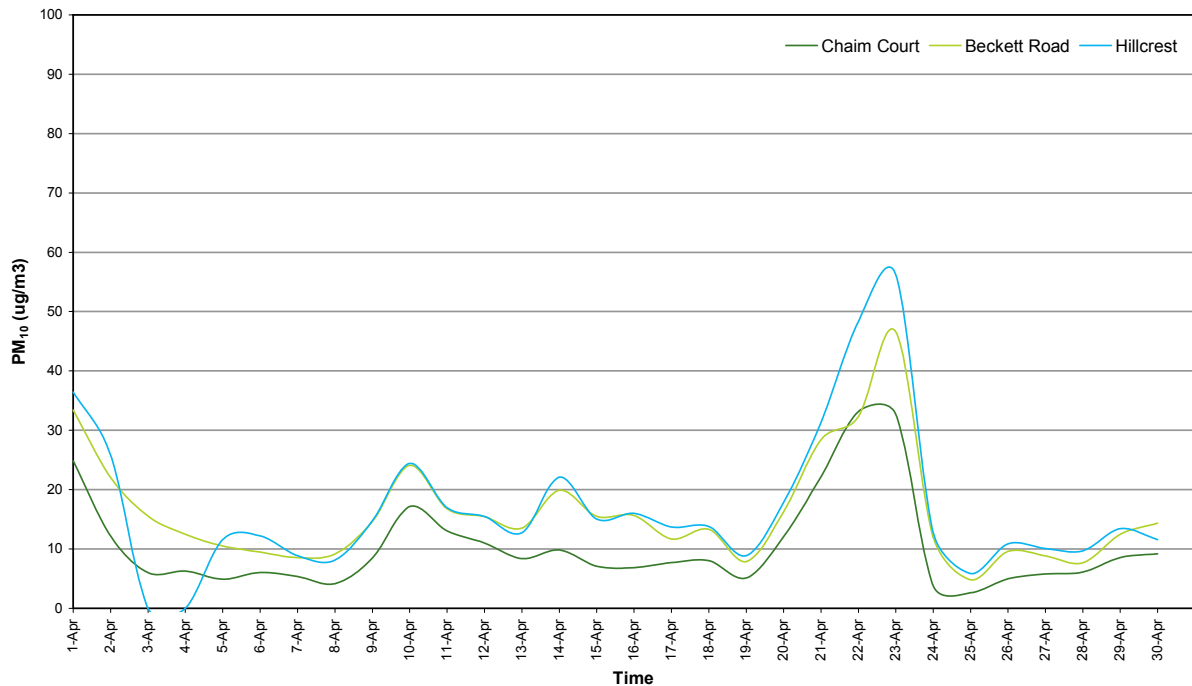


Figure 5: PM<sub>10</sub> Concentration (24 Hour Average)



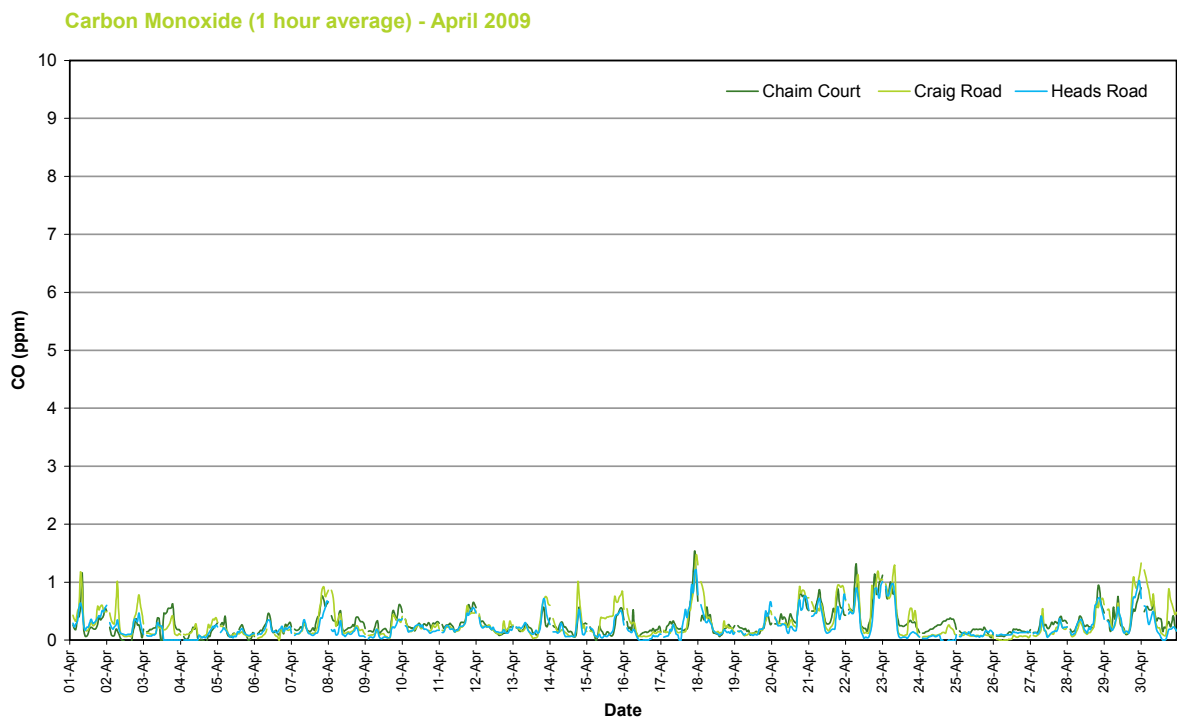
## 6.2.3 Carbon Monoxide

### 6.2.3.1 1-Hour Average

Carbon monoxide (1-hour average) concentration statistics for the reporting period are given in Table 10. A plot of carbon monoxide (1-hour average) concentration for the reporting period is presented in Figure 6.

**Table 10: Carbon Monoxide Concentration Percentiles (1 Hour Average)**

Station	Carbon Monoxide Concentration (ppm) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	1.5	1.0	0.89	0.71	0.56	0.36	0.23
Craig Rd	1.5	1.2	1.0	0.88	0.71	0.39	0.19
Heads Rd	1.2	0.96	0.89	0.72	0.53	0.3	0.17



*Figure 6: Carbon Monoxide Concentration (1 Hour Average)*

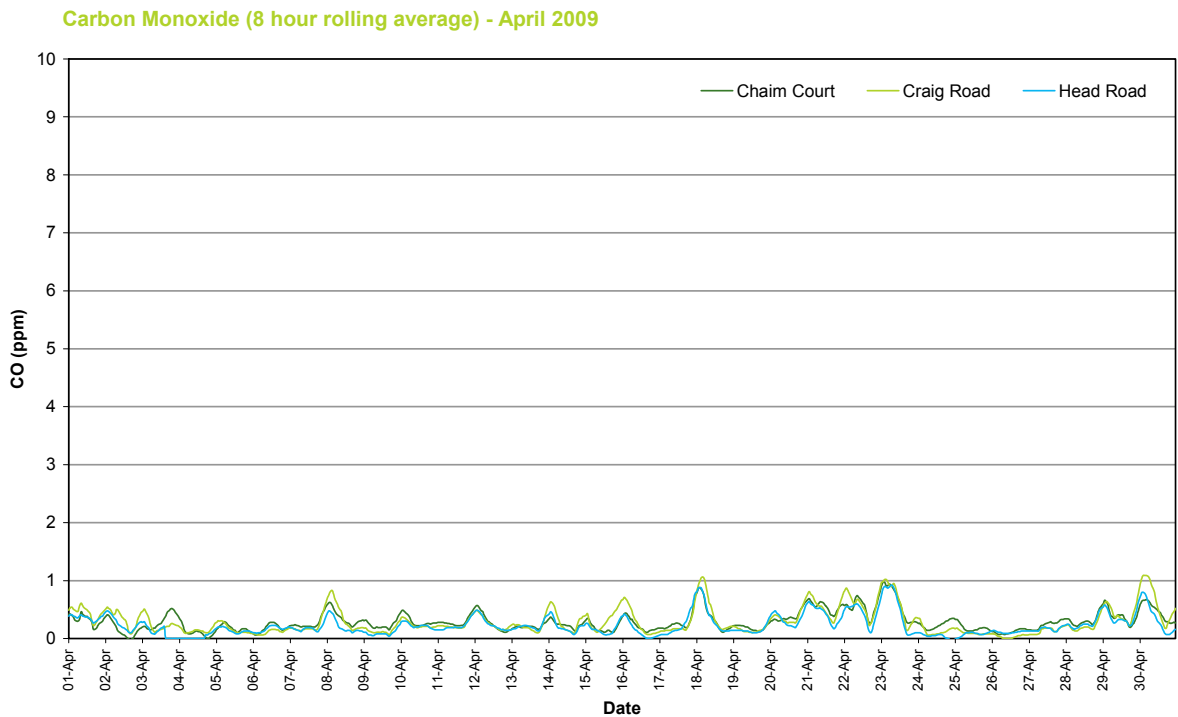


**6.2.3.2 8-Hour Rolling Average**

Carbon monoxide (8-hour rolling average) concentration statistics for the reporting period are given in Table 11. A plot of carbon monoxide (8-hour rolling average) concentration for the reporting period is presented in Figure 7.

**Table 11: Carbon Monoxide Concentration Percentiles (8 Hour Rolling Average)**

Station	Carbon Monoxide Concentration (ppm) (8-Hour Rolling Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	0.97	0.89	0.8	0.63	0.56	0.35	0.25
Craig Rd	1.1	1.0	0.97	0.78	0.62	0.4	0.21
Heads Rd	0.92	0.87	0.79	0.58	0.48	0.31	0.19



*Figure 7: Carbon Monoxide Concentration (8 Hour Rolling Average)*



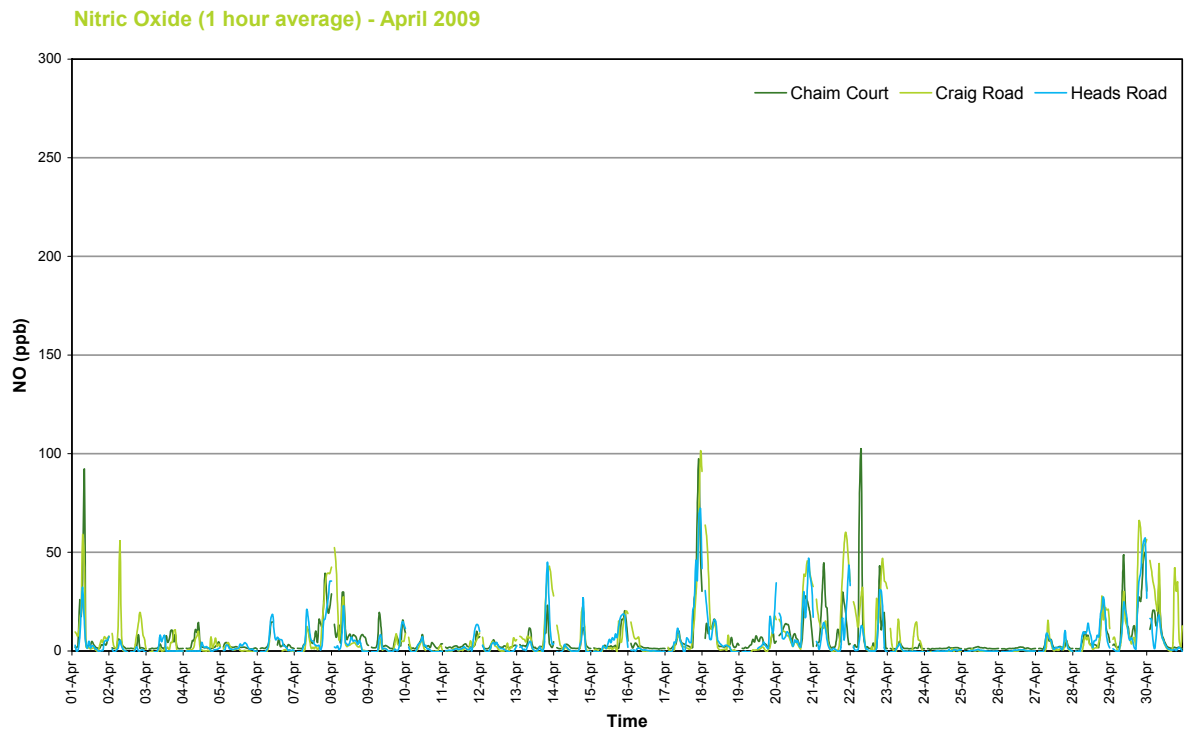
## 6.2.4 Oxides of Nitrogen

### 6.2.4.1 Nitric Oxide

Nitric oxide (1-hour average) concentration statistics for the reporting period are given in Table 12. A plot of nitric oxide (1-hour average) concentration for the reporting period is presented in Figure 8.

**Table 12: Nitric Oxide Concentration Percentiles (1 Hour Average)**

Station	Nitric Oxide Concentration (ppm) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	100	49	34	24	14	5.9	2.3
Craig Rd	100	59	53	39	23	7.1	1.2
Heads Rd	72	45	35	23	16	5.3	1.1



*Figure 8: Nitric Oxide Concentration (1 Hour Average)*

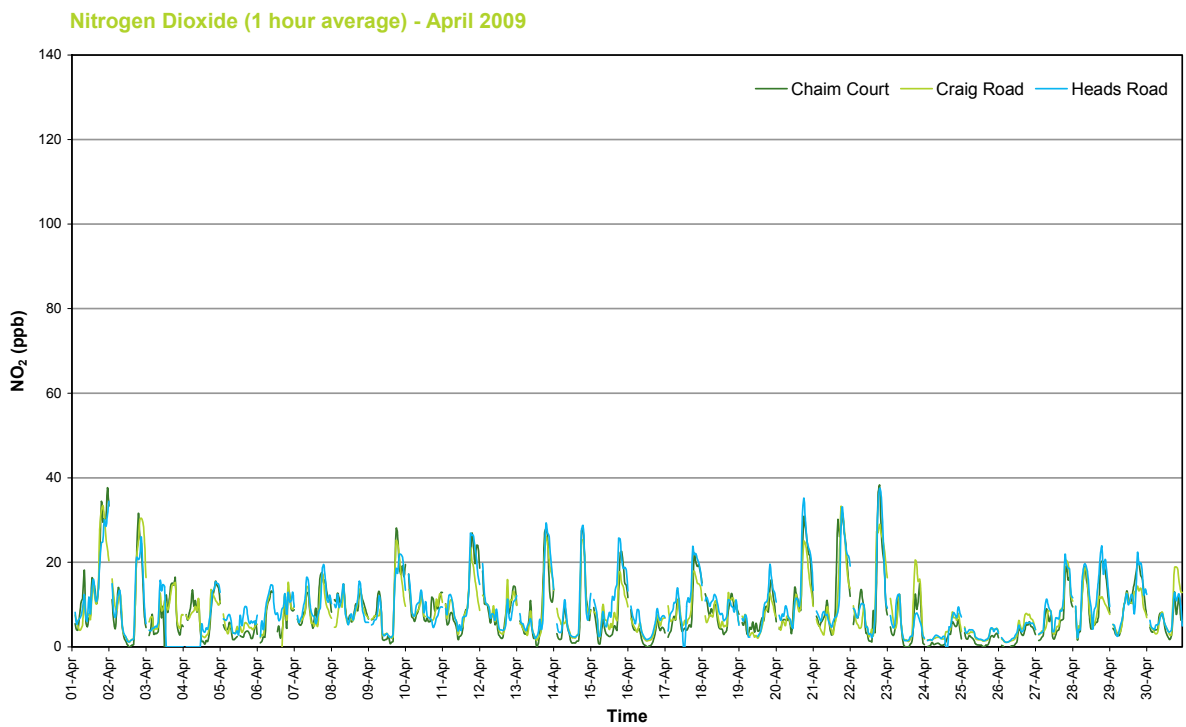


**6.2.4.2 Nitrogen Dioxide**

Nitrogen dioxide (1-hour average) concentration statistics for the reporting period are given in Table 13. A plot of nitrogen dioxide (1-hour average) concentration for the reporting period is presented in Figure 9.

**Table 13: Nitrogen Dioxide Concentration Percentiles (1 Hour Average)**

Station	Nitrogen Dioxide Concentration (ppb) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	38	31	28	22	17	11	6.5
Craig Rd	33	29	26	21	16	11	7.0
Heads Rd	38	31	28	22	19	12	7.6



*Figure 9: Nitrogen Dioxide Concentration (1 Hour Average)*



### 6.2.5 Meteorological Data

Wind speed and direction for each of the monitoring stations are presented as wind roses in Figures 10 – 12.

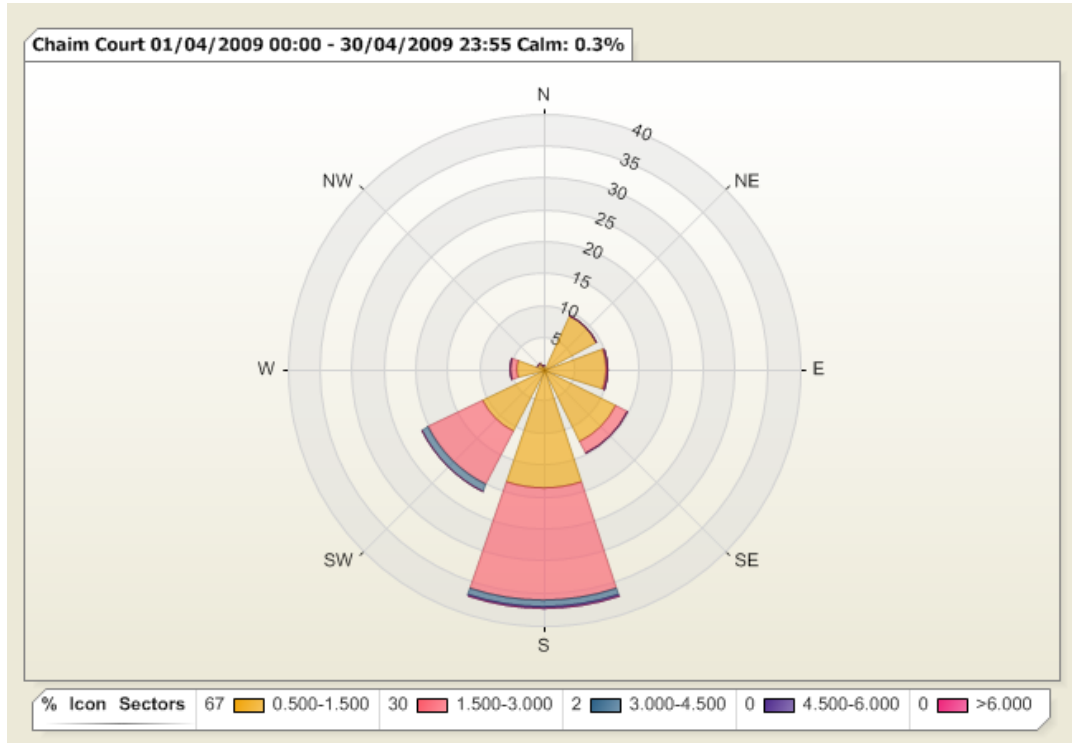


Figure 10: Chaim Court Wind Rose

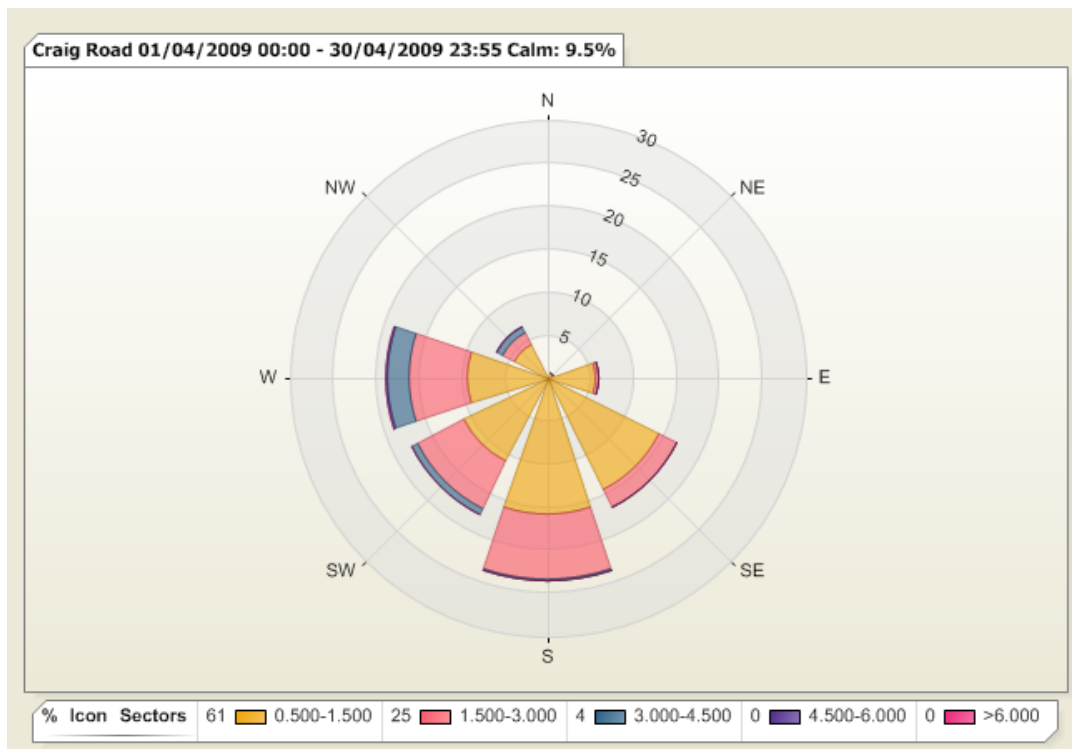


Figure 11: Craig Road Wind Rose



# EASTLINK AMBIENT AIR QUALITY MONITORING REPORT: APRIL-JUNE 2009

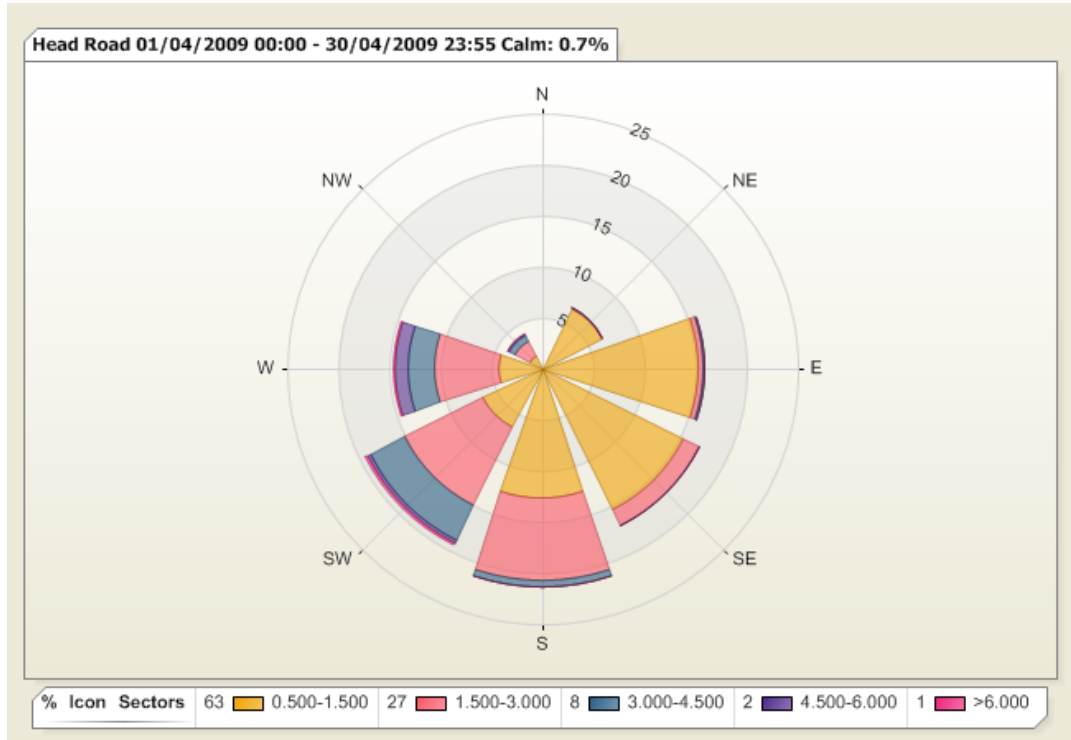


Figure 12: Heads Road Wind Rose



### 6.3 Data Validation and Exception

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 14 – 16 list the data exceptions for Chaim Court, Craig Road and Heads Road monitoring stations respectively. Data during automatic calibrations of the gaseous analysers has also been removed from the data sets.

**Table 14: Data Exceptions - Chaim Court**

Start	End	Parameter	Reason
3/04/2009 11:50	3/04/2009 13:00	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
3/04/2009 11:10	3/04/2009 12:45	CO	Maintenance/calibration
8/04/2009 14:55	8/04/2009 15:55	PM <sub>10</sub>	Maintenance/calibration
8/04/2009 14:45	8/04/2009 16:05	PM <sub>2.5</sub>	Maintenance/calibration

**Table 15: Data Exceptions - Craig Road**

Start	End	Parameter	Reason
6/04/2009 15:50	6/04/2009 17:00	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
6/04/2009 16:40	6/04/2009 17:45	PM <sub>10</sub>	Maintenance/calibration
16/04/2009 13:15	17/04/2009 17:15	Temperature, RH	Maintenance/calibration
30/04/2009 12:25	30/04/2009 12:35	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration

**Table 16: Data Exceptions - Heads Road**

Start	End	Parameter	Reason
3/04/2009 12:55	4/04/2009 11:20	All parameters	Communication error
15/04/2009 7:15	15/04/2009 7:50	All parameters	Power failure
17/04/2009 12:40	17/04/2009 14:00	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
17/04/2009 13:15	17/04/2009 14:30	PM <sub>10</sub>	Maintenance/calibration
22/04/2009 11:25	22/04/2009 13:35	PM <sub>10</sub>	Maintenance/calibration
24/04/2009 14:20	24/04/2009 15:15	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration





## 7.0 AMBIENT AIR QUALITY MONITORING PERIOD: 01/05/2009 – 31/05/2009

### 7.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance procedures.

The data capture statistics for the reporting period 1st May to 31<sup>st</sup> May, 2009 are shown in Tables 17-19. Averages were only collected for those periods where the 5-minute data constituted 75% data capture.

Section 7.3 provides further information on the reasons for invalid data periods.

**Table 17: Data Capture Statistics - 1 Hour Average**

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM <sub>2.5</sub>	Chaim Crt.	641	744	86.2%
PM <sub>10</sub>	Chaim Crt	739	744	99.3%
	Craig Rd.	742	744	99.7%
	Heads Rd.	742	744	99.7%
NO, NO <sub>2</sub>	Chaim Crt	711	744	95.6%
	Craig Rd.	712	744	95.7%
	Heads Rd.	711	744	95.6%
CO	Chaim Crt	710	744	95.4%
	Craig Rd.	712	744	95.7%
	Heads Rd.	712	744	95.7%

**Table 18: Data Capture Statistics - 8 Hour Rolling Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
CO	Chaim Crt	720	720	100.0%
	Craig Rd.	720	720	100.0%
	Heads Rd.	720	720	100.0%

**Table 19: Data Capture Statistics - 24 Hour Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM <sub>2.5</sub>	Chaim Crt.	26	31	83.9%
PM <sub>10</sub>	Chaim Crt	30	30	100.0%
	Craig Rd.	30	30	100.0%
	Heads Rd.	30	30	100.0%



## 7.2 Results

### 7.2.1 PM<sub>2.5</sub>

PM<sub>2.5</sub> was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour and 24-hour averages for reporting.

PM<sub>2.5</sub> (1-hour average) concentration statistics for the reporting period are given in Table 20. A plot of PM<sub>2.5</sub> (1-hour average) concentration for the reporting period is presented in Figure 13.

**Table 20: PM<sub>2.5</sub> Concentration Percentiles (1 Hour Average)**

Station	PM <sub>2.5</sub> Concentration (µg/m <sup>3</sup> ) (1-hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	72	69	59	42	36	25	15

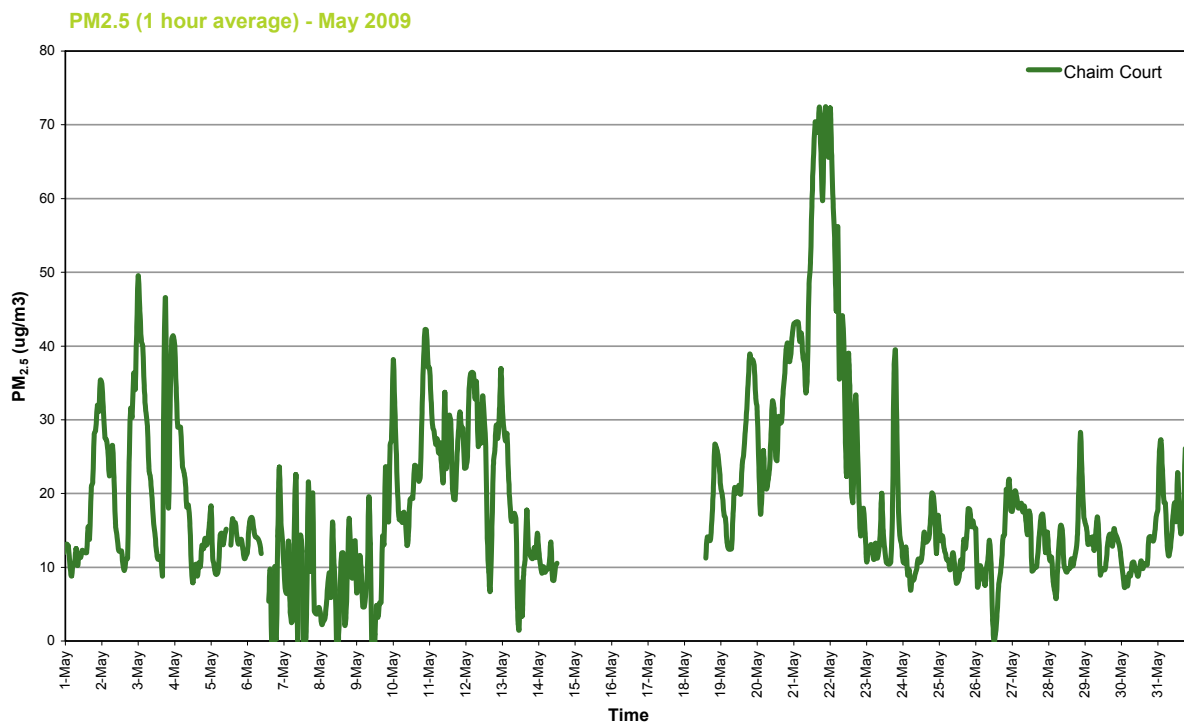


Figure 13: PM<sub>2.5</sub> Concentration (1 Hour Average)



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PM<sub>2.5</sub> (24-hour average) concentration statistics for the reporting period are given in Table 21. A plot of PM<sub>2.5</sub> (24-hour average) concentration for the reporting period is presented in Figure 14.

**Table 21: PM<sub>2.5</sub> Concentration Percentiles (24 Hour Average)**

Station	PM <sub>2.5</sub> Concentration (µg/m <sup>3</sup> ) (24-hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	54	49	45	35	28	24	16

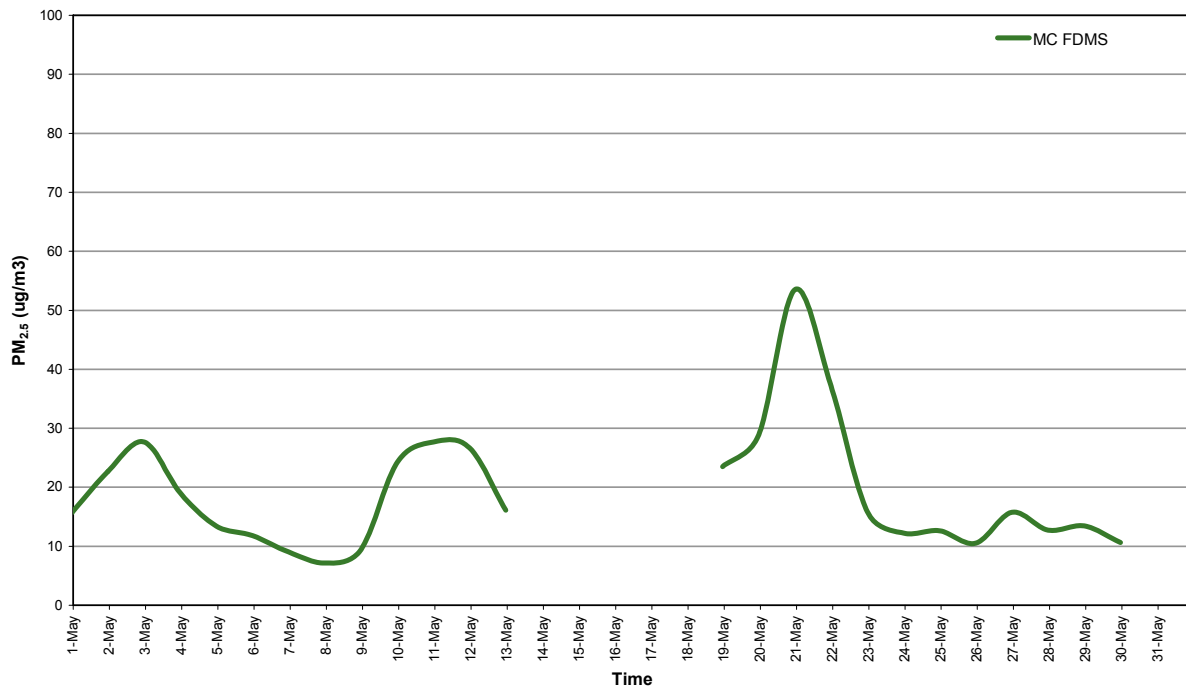


Figure 14: PM<sub>2.5</sub> Concentration (24 Hour Average)



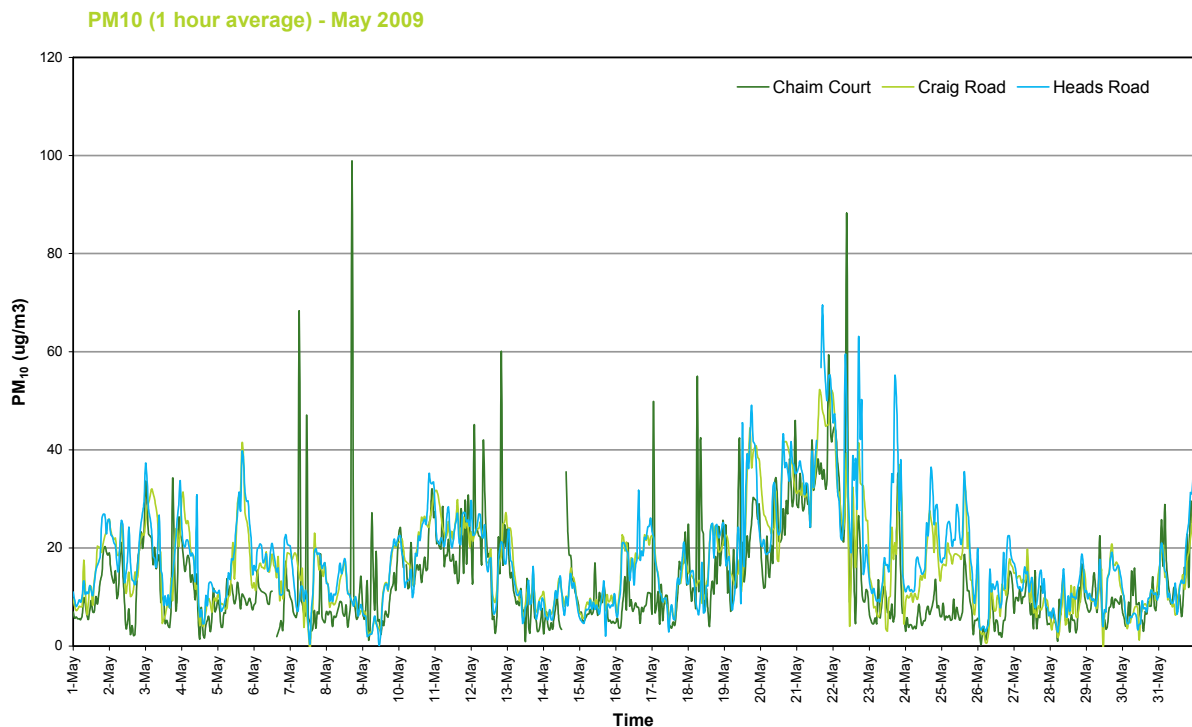
### 7.3 PM<sub>10</sub>

PM<sub>10</sub> was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour and 24-hour averages for reporting.

PM<sub>10</sub> (1-hour average) concentration statistics for the reporting period are given in Table 22. A plot of PM<sub>10</sub> (1-hour average) concentration for the reporting period is presented in Figure 15.

**Table 22: PM<sub>10</sub> Concentration Percentiles (1 Hour Average)**

Station	PM <sub>10</sub> Concentration (µg/m <sup>3</sup> ) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	99	47	42	33	26	17	10
Craig Rd	52	46	42	34	30	22	15
Heads Rd	69	54	48	37	31	22	15



*Figure 15: PM<sub>10</sub> Concentration (1 Hour Average)*



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PM<sub>10</sub> (24-hour average) concentration statistics for the reporting period are given in Table 23. A plot of PM<sub>10</sub> (24-hour average) concentration for the reporting period is presented in Figure 16.

**Table 23: PM<sub>10</sub> Concentration Percentiles (24 Hour Average)**

Station	PM <sub>10</sub> Concentration (µg/m <sup>3</sup> ) (24-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	35	32	29	25	22	17	10
Craig Rd.	38	36	34	30	26	19	15
Heads Rd	43	40	38	32	26	21	17

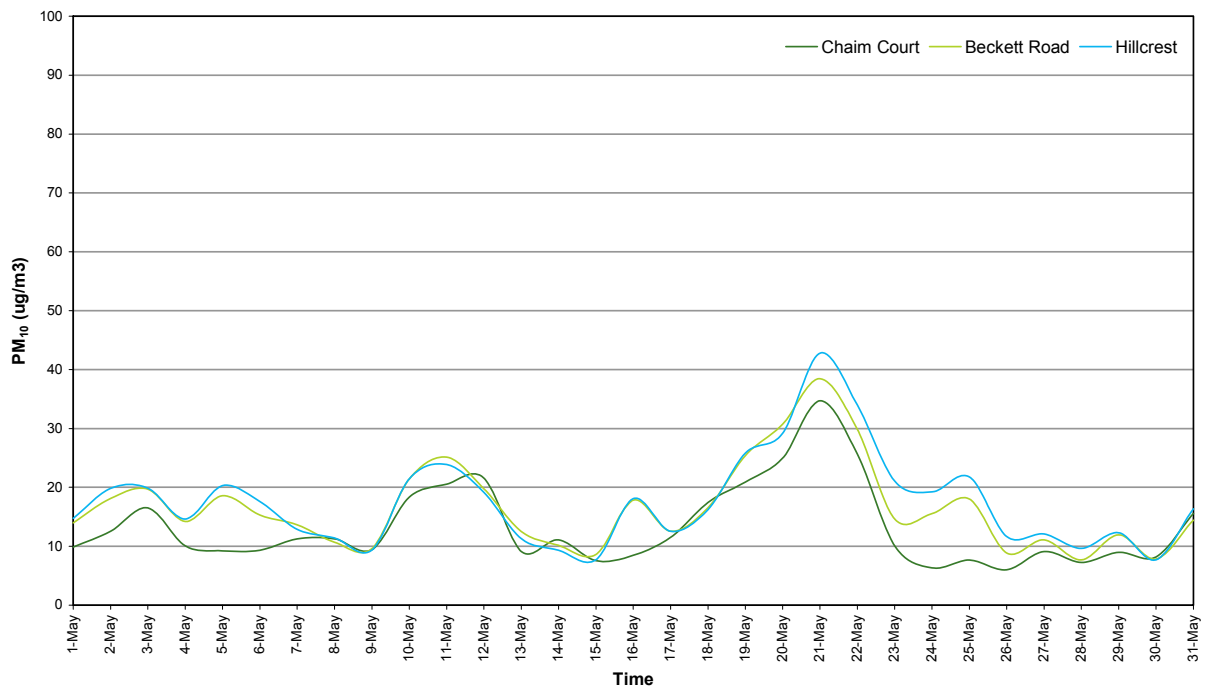


Figure 16: PM<sub>10</sub> Concentration (24 Hour Average)



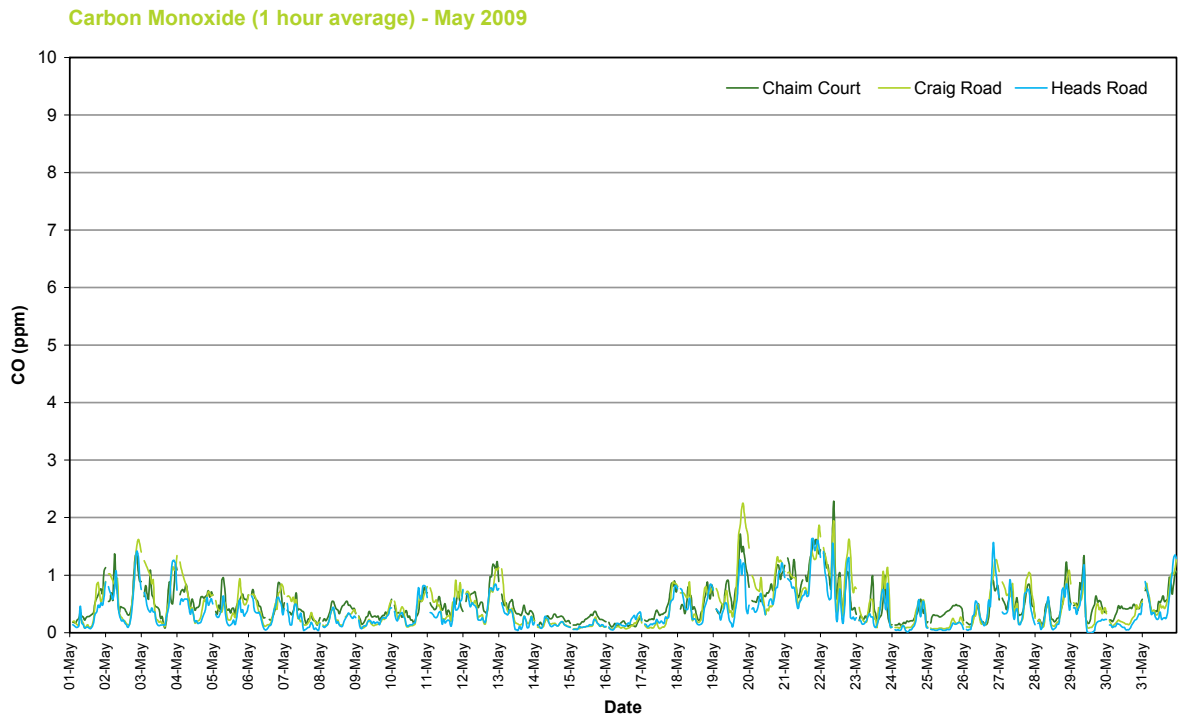
### 7.3.1 Carbon Monoxide

#### 7.3.1.1 1-Hour Average

Carbon monoxide (1-hour average) concentration statistics for the reporting period are given in Table 24. A plot of carbon monoxide (1-hour average) concentration for the reporting period is presented in Figure 17.

**Table 24: Carbon Monoxide Concentration Percentiles (1 Hour Average)**

Station	Carbon Monoxide Concentration (ppm) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	2.3	1.4	1.4	1.1	0.91	0.63	0.42
Craig Rd	2.2	1.7	1.5	1.2	1.0	0.68	0.36
Heads Rd	1.6	1.4	1.3	1.0	0.78	0.5	0.27



*Figure 17: Carbon Monoxide Concentration (1 Hour Average)*

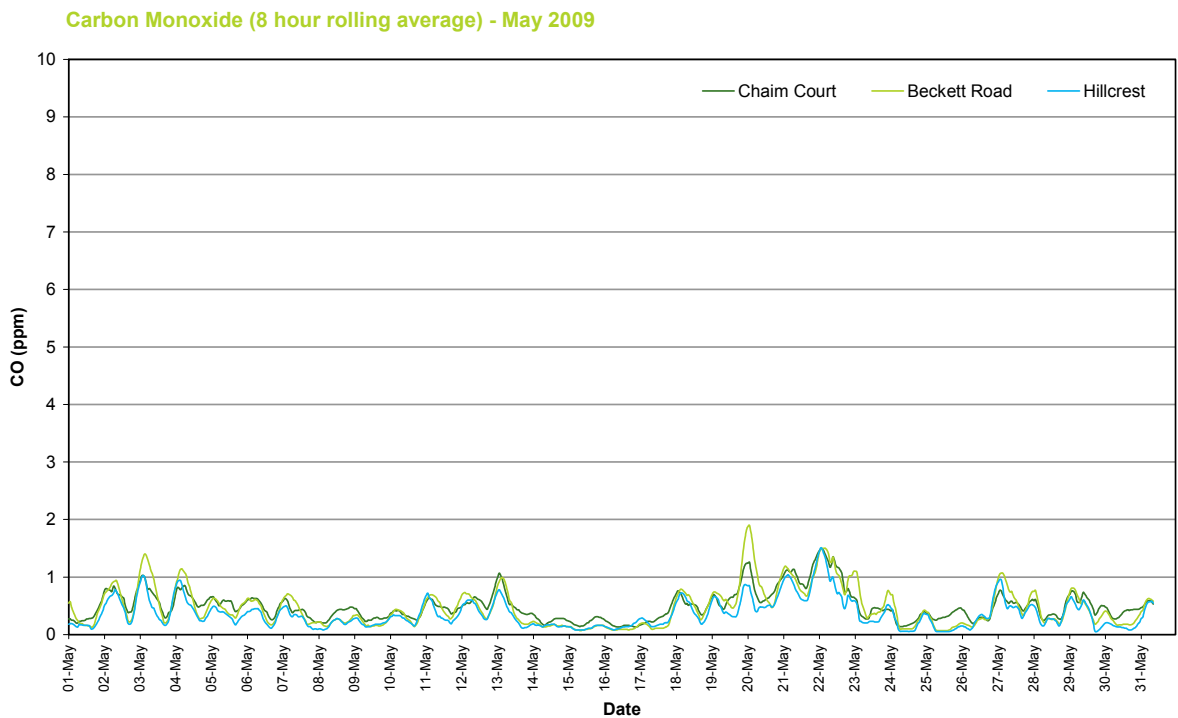


**7.3.1.2 8-Hour Rolling Average**

Carbon monoxide (8-hour rolling average) concentration statistics for the reporting period are given in Table 25. A plot of carbon monoxide (8-hour rolling average) concentration for the reporting period is presented in Figure 18.

**Table 25: Carbon Monoxide Concentration Percentiles (8 Hour Rolling Average)**

Station	Carbon Monoxide Concentration (ppm) (8-Hour Rolling Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	1.5	1.3	1.2	1.1	0.82	0.61	0.44
Craig Rd	1.9	1.5	1.4	1.1	0.96	0.66	0.38
Heads Rd	1.5	1.2	1.0	0.87	0.7	0.49	0.29



*Figure 18: Carbon Monoxide Concentration (8 Hour Rolling Average)*



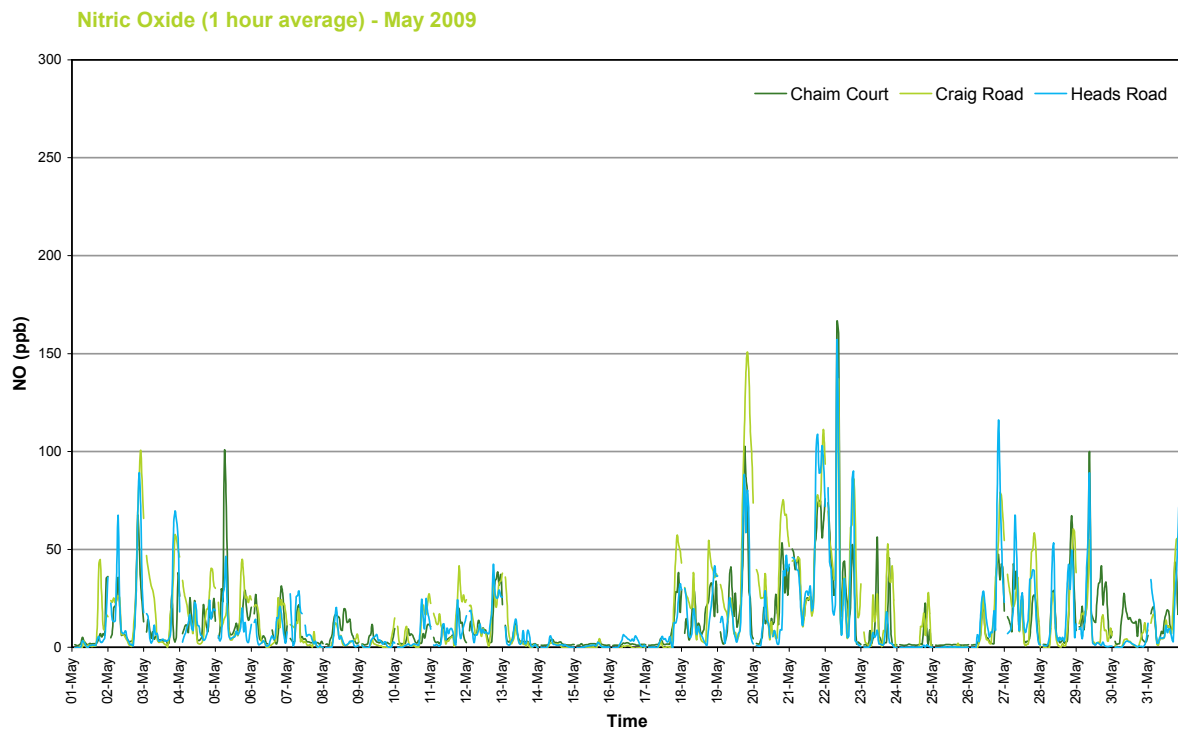
## 7.3.2 Oxides of Nitrogen

### 7.3.2.1 Nitric Oxide

Nitric oxide (1-hour average) concentration statistics for the reporting period are given in Table 26. A plot of nitric oxide (1-hour average) concentration for the reporting period is presented in Figure 19.

**Table 26: Nitric Oxide Concentration Percentiles (1 Hour Average)**

Station	Nitric Oxide Concentration (ppm) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	170	78	66	44	33	17	5.9
Craig Rd	150	110	84	59	45	23	6.6
Heads Rd	160	90	84	54	33	14	4.5



*Figure 19: Nitric Oxide Concentration (1 Hour Average)*



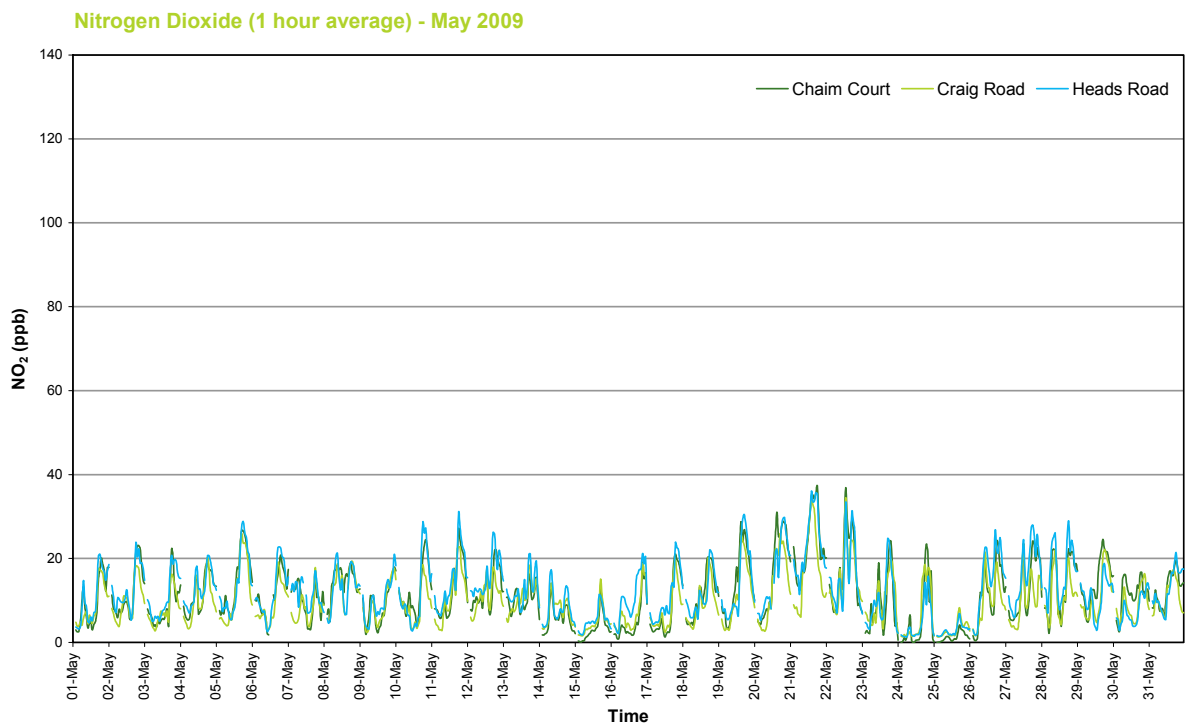


**7.3.2.2 Nitrogen Dioxide**

Nitrogen dioxide (1-hour average) concentration statistics for the reporting period are given in Table 27. A plot of nitrogen dioxide (1-hour average) concentration for the reporting period is presented in Figure 20.

**Table 27: Nitrogen Dioxide Concentration Percentiles (1 Hour Average)**

Station	Nitrogen Dioxide Concentration (ppb) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	37	30	28	24	21	16	9.8
Craig Rd	34	26	24	21	18	13	8.6
Heads Rd	36	31	29	26	22	17	11



*Figure 20: Nitrogen Dioxide Concentration (1 Hour Average)*



### 7.3.3 Meteorological Data

Wind speed and direction for each of the monitoring stations are presented as wind roses in Figures 21 – 23.

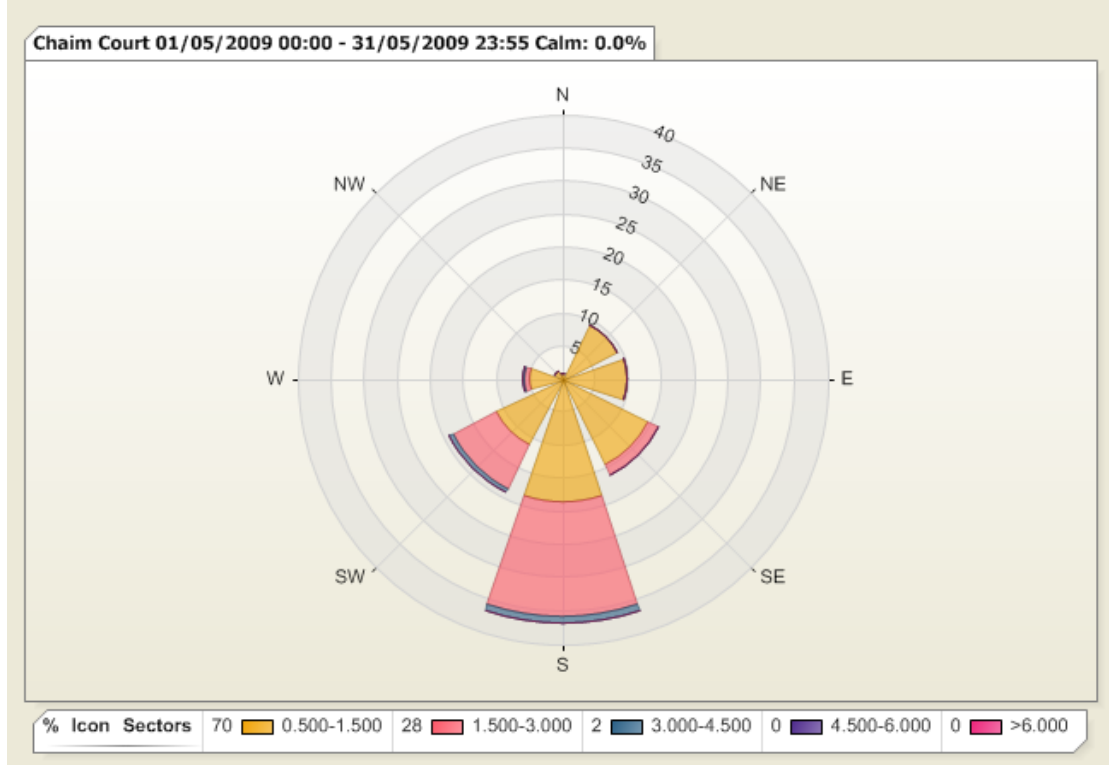


Figure 21: Chaim Court Wind Rose

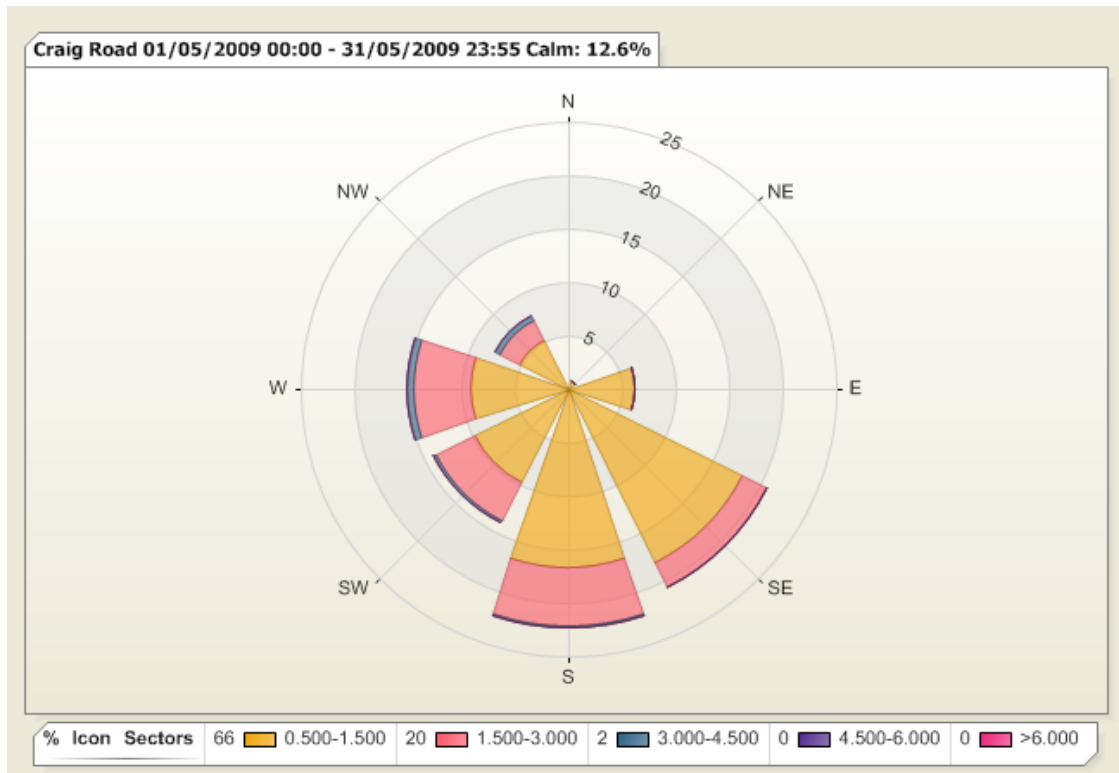


Figure 22: Craig Road Wind Rose

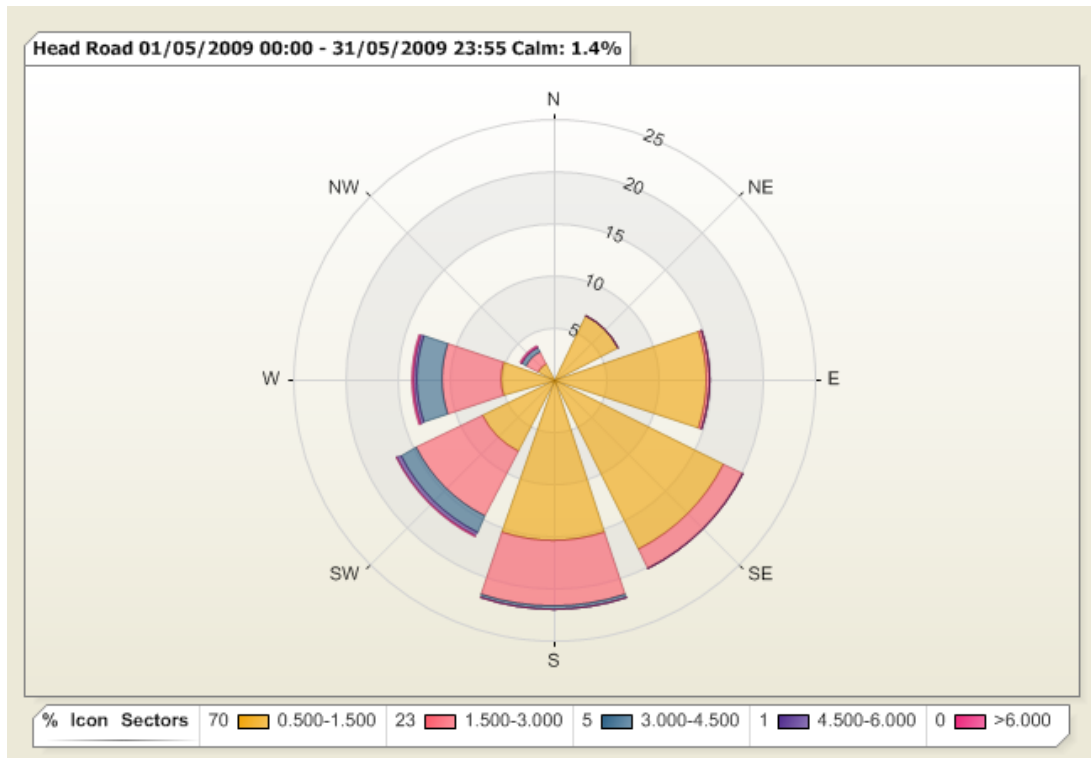


Figure 23: Heads Road Wind Rose



## 7.4 Data Validation and Exception

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 28 – 30 list the data exceptions for Chaim Court, Craig Road and Heads Road monitoring stations respectively. Data during automatic calibrations of the gaseous analysers has also been removed from the data sets.

**Table 28: Data Exceptions - Chaim Court**

Start	End	Parameter	Reason
5/05/2009 11:45	5/05/2009 14:05	PM <sub>2.5</sub>	Maintenance/calibration
6/05/2009 12:00	6/05/2009 13:30	CO	Maintenance/calibration
6/05/2009 12:00	6/05/2009 13:15	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
6/05/2009 13:00	6/05/2009 14:40	PM <sub>10</sub>	Maintenance/calibration
6/05/2009 1:40	6/05/2009 15:10	PM <sub>2.5</sub>	Maintenance/calibration
10/05/2009 3:55	10/05/2009 4:35	PM <sub>10</sub>	Invalid data - Noise
14/05/2009 13:55	18/05/2009 14:15	PM <sub>2.5</sub>	Invalid data - Noise <sup>1</sup>
21/05/2009 13:15	21/05/2009 14:00	CO	Maintenance/calibration

**Table 29: Data Exceptions - Craig Road**

Start	End	Parameter	Reason
8/05/2009 15:30	8/05/2009 15:35	CO	Maintenance/calibration
8/05/2009 16:00	8/05/2009 16:20	CO	Maintenance/calibration
8/05/2009 15:30	8/05/2009 16:00	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
8/05/2009 16:40	8/05/2009 17:35	PM <sub>10</sub>	Maintenance/calibration

**Table 30: Data Exceptions - Heads Road**

Start	End	Parameter	Reason
7/05/2009 10:55	7/05/2009 11:40	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
20/05/2009 11:50	20/05/2009 12:25	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
20/05/2009 12:25	20/05/2009 12:55	CO	Maintenance/calibration
21/05/2009 14:30	21/05/2009 15:25	PM <sub>10</sub>	Maintenance/calibration

<sup>1</sup> In the opinion of the reviewer.



## 8.0 AMBIENT AIR QUALITY MONITORING PERIOD: 01/06/2009 – 30/06/2009

### 8.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance procedures.

The data capture statistics for the reporting period 1st June to 30<sup>th</sup> June 2009 are shown in Tables 31-33. Averages were only collected for those periods where the 5-minute data constituted 75% data capture.

Section 8.3 provides further information on the reasons for invalid data periods.

**Table 31: Data Capture Statistics - 1 Hour Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM <sub>2.5</sub>	Chaim Crt.	715	720	99.3%
PM <sub>10</sub>	Chaim Crt.	716	720	99.4%
	Craig Rd.	716	720	99.4%
	Heads Rd.	713	720	99.0%
NO, NO <sub>2</sub>	Chaim Crt.	575	720	79.9%
	Craig Rd.	687	720	95.4%
	Heads Rd.	640	720	88.9%
CO	Chaim Crt.	688	720	95.6%
	Craig Rd.	689	720	95.7%
	Heads Rd.	688	720	95.6%

**Table 32: Data Capture Statistics - 8 Hour Rolling Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
CO	Chaim Crt.	720	720	100.0%
	Craig Rd.	720	720	100.0%
	Heads Rd.	720	720	100.0%

**Table 33: Data Capture Statistics - 24 Hour Averages**

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM <sub>2.5</sub>	Chaim Crt.	30	30	100.0%
PM <sub>10</sub>	Chaim Crt.	30	30	100.0%
	Craig Rd.	30	30	100.0%
	Heads Rd.	30	30	100.0%



## 8.2 Results

### 8.2.1 PM<sub>2.5</sub>

PM<sub>2.5</sub> was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour and 24-hour averages for reporting.

PM<sub>2.5</sub> (1-hour average) concentration statistics for the reporting period are given in Table 34. A plot of PM<sub>2.5</sub> (1-hour average) concentration for the reporting period is presented in Figure 24.

**Table 34: PM<sub>2.5</sub> Concentration Percentiles (1 Hour Average)**

Station	PM <sub>2.5</sub> Concentration (µg/m <sup>3</sup> ) (1-hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim CRT	70	51	46	36	30	20	13

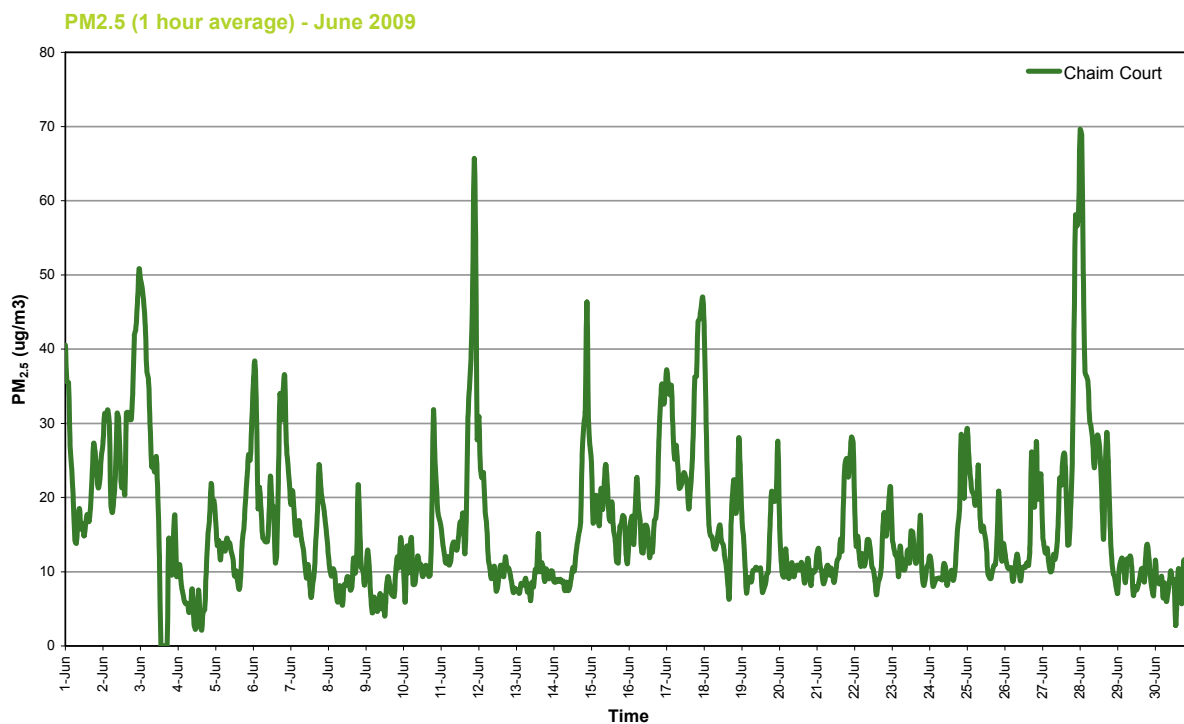


Figure 24: PM<sub>2.5</sub> Concentration (1 Hour Average)



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PM<sub>2.5</sub> (24-hour average) concentration statistics for the reporting period are given in Table 35. A plot of PM<sub>2.5</sub> (24-hour average) concentration for the reporting period is presented in Figure 25.

**Table 35: PM<sub>2.5</sub> Concentration Percentiles (24 Hour Average)**

Station	PM <sub>2.5</sub> Concentration (µg/m <sup>3</sup> ) (24-hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	30	30	30	29	26	22	15

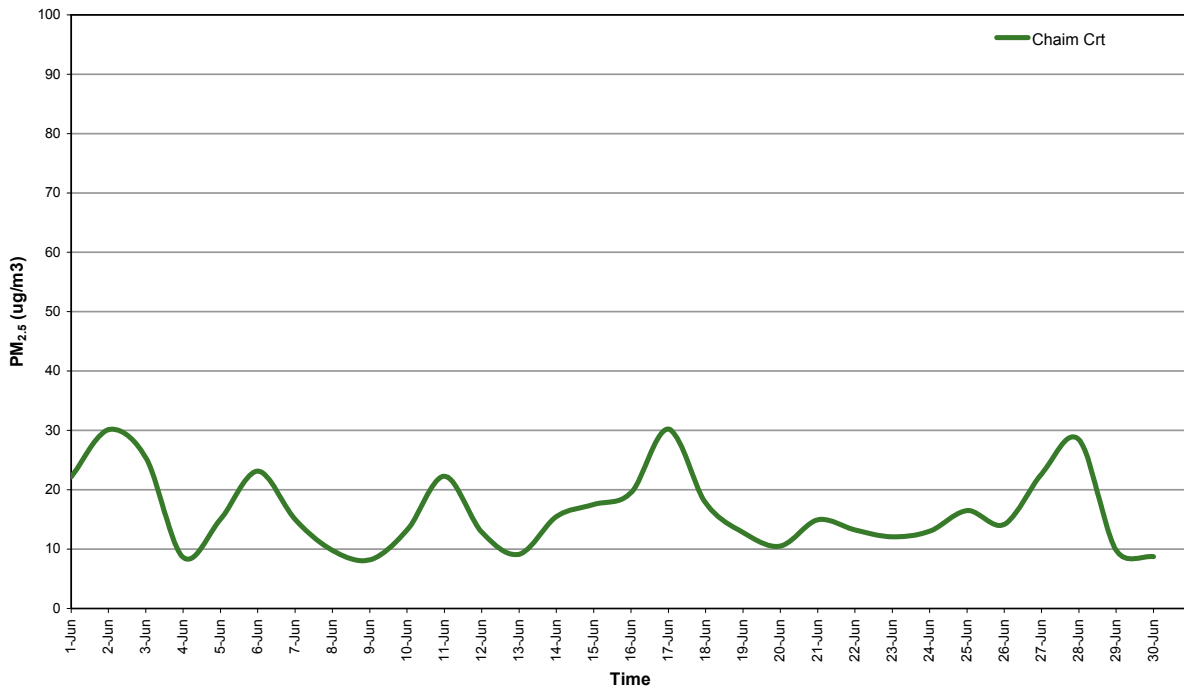


Figure 25: PM<sub>2.5</sub> Concentration (24 Hour Average)



### 8.3 PM<sub>10</sub>

PM<sub>10</sub> was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour and 24-hour averages for reporting.

PM<sub>10</sub> (1-hour average) concentration statistics for the reporting period are given in Table 36. A plot of PM<sub>10</sub> (1-hour average) concentration for the reporting period is presented in Figure 26.

**Table 36: PM<sub>10</sub> Concentration Percentiles (1 Hour Average)**

Station	PM <sub>10</sub> Concentration (µg/m <sup>3</sup> ) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	43	29	27	23	18	12	7.1
Craig Rd	45	33	30	27	23	16	10
Heads Rd	45	36	32	26	21	14	9.0

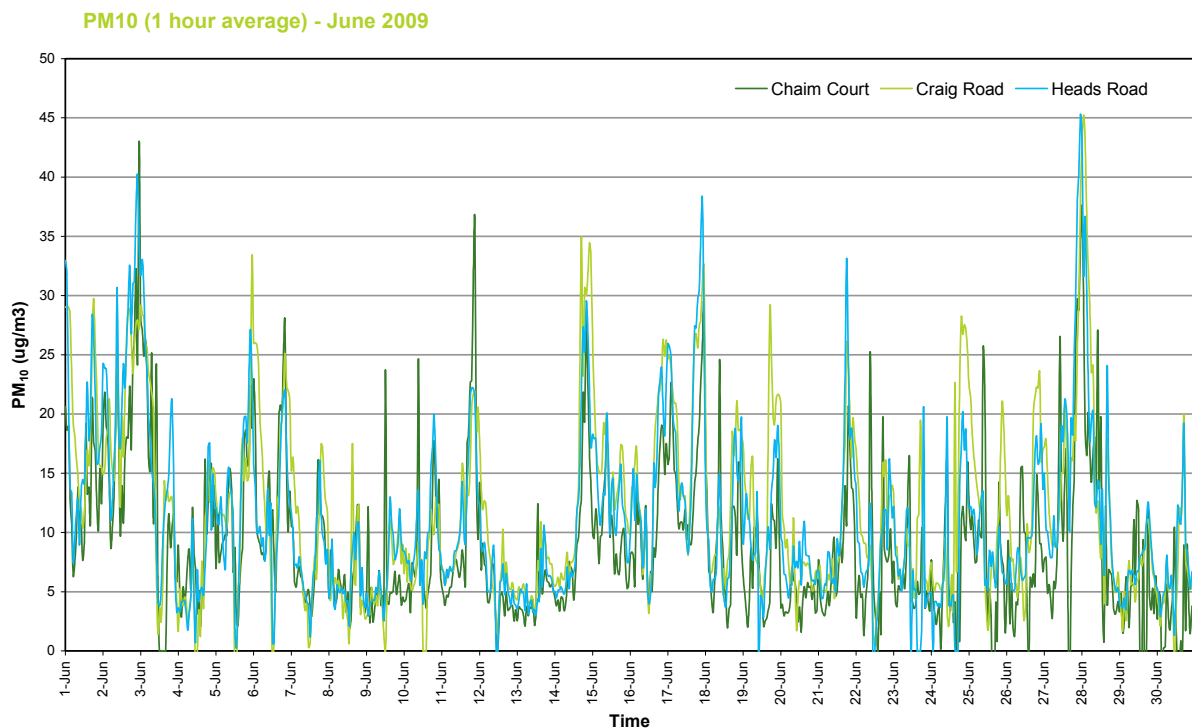


Figure 26: PM<sub>10</sub> Concentration (1 Hour Average)





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PM<sub>10</sub> (24-hour average) concentration statistics for the reporting period are given in Table 37. A plot of PM<sub>10</sub> (24-hour average) concentration for the reporting period is presented in Figure 27.

**Table 37: PM<sub>10</sub> Concentration Percentiles (24 Hour Average)**

Station	PM <sub>10</sub> Concentration (µg/m <sup>3</sup> ) (24-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	19	18	17	15	14	11	8.1
Craig Rd.	21	21	21	20	18	15	12
Heads Rd	25	23	22	19	18	13	10

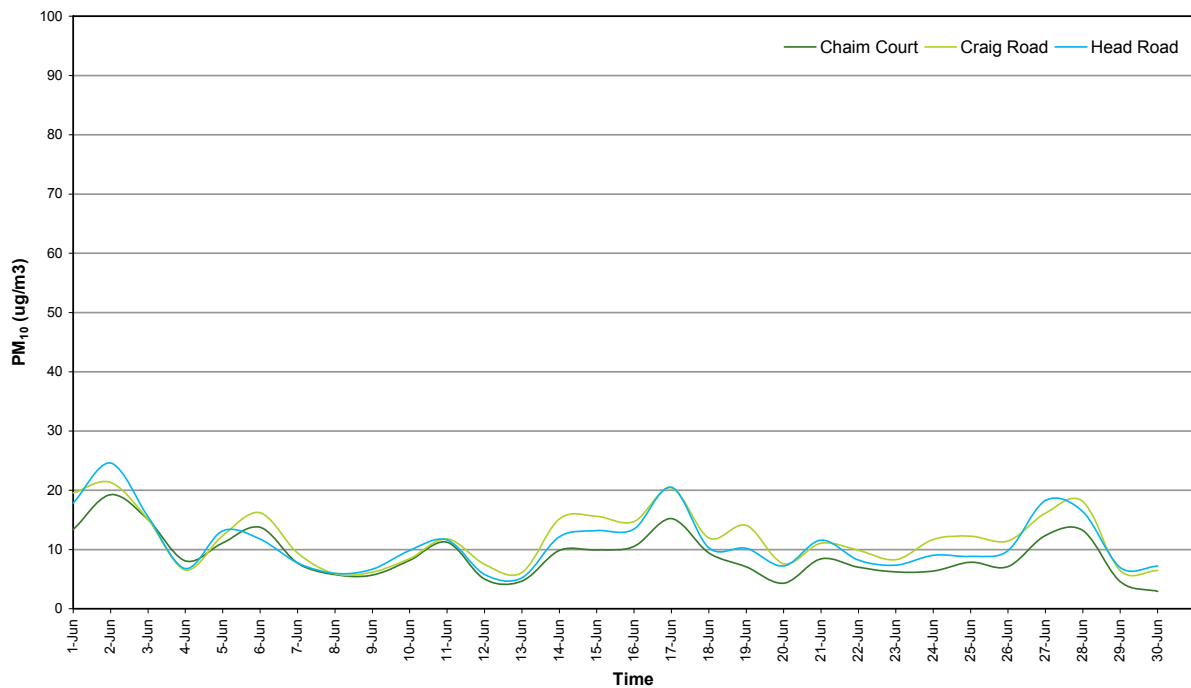


Figure 27: PM<sub>10</sub> Concentration (24 Hour Average)



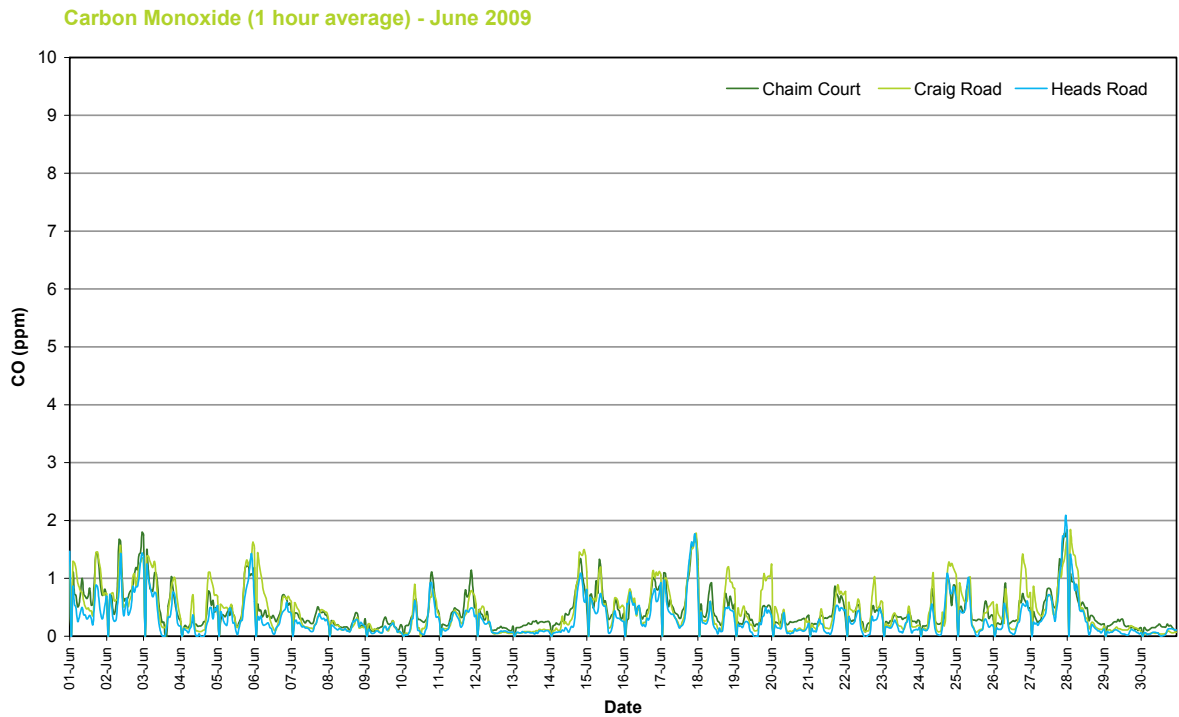
### 8.3.1 Carbon Monoxide

#### 8.3.1.1 1-Hour Average

Carbon monoxide (1-hour average) concentration statistics for the reporting period are given in Table 38. A plot of carbon monoxide (1-hour average) concentration for the reporting period is presented in Figure 28.

**Table 38: Carbon Monoxide Concentration Percentiles (1 Hour Average)**

Station	Carbon Monoxide Concentration (ppm) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	1.8	1.6	1.4	1.1	0.89	0.58	0.34
Craig Rd	1.8	1.5	1.4	1.3	1.1	0.67	0.35
Heads Rd	2.1	1.6	1.4	0.92	0.74	0.44	0.22



*Figure 28: Carbon Monoxide Concentration (1 Hour Average)*

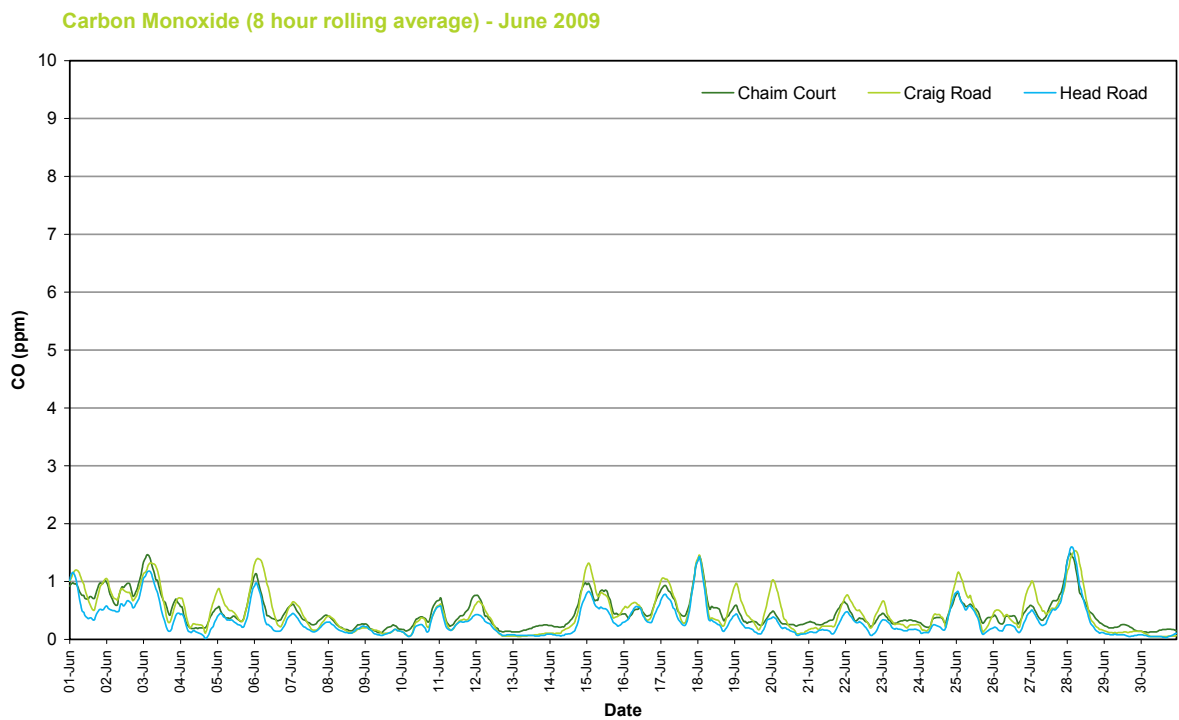


**8.3.1.2 8-Hour Rolling Average**

Carbon monoxide (8-hour rolling average) concentration statistics for the reporting period are given in Table 39. A plot of carbon monoxide (8-hour rolling average) concentration for the reporting period is presented in Figure 29.

**Table 39: Carbon Monoxide Concentration Percentiles (8 Hour Rolling Average)**

Station	Carbon Monoxide Concentration (ppm) (8-Hour Rolling Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	1.5	1.4	1.3	0.99	0.85	0.59	0.38
Craig Rd	1.5	1.4	1.3	1.2	1.0	0.68	0.38
Heads Rd	1.6	1.3	1.1	0.9	0.67	0.43	0.25



*Figure 29: Carbon Monoxide Concentration (8 Hour Rolling Average)*



### 8.3.2 Oxides of Nitrogen

#### 8.3.2.1 Nitric Oxide

Nitric oxide (1-hour average) concentration statistics for the reporting period are given in Table 40. A plot of nitric oxide (1-hour average) concentration for the reporting period is presented in Figure 30.

**Table 40: Nitric Oxide Concentration Percentiles (1 Hour Average)**

Station	Nitric Oxide Concentration (ppm) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	150	110	88	64	40	14	2.8
Craig Rd	120	100	90	70	55	24	5.0
Heads Rd	130	110	96	58	37	11	1.7

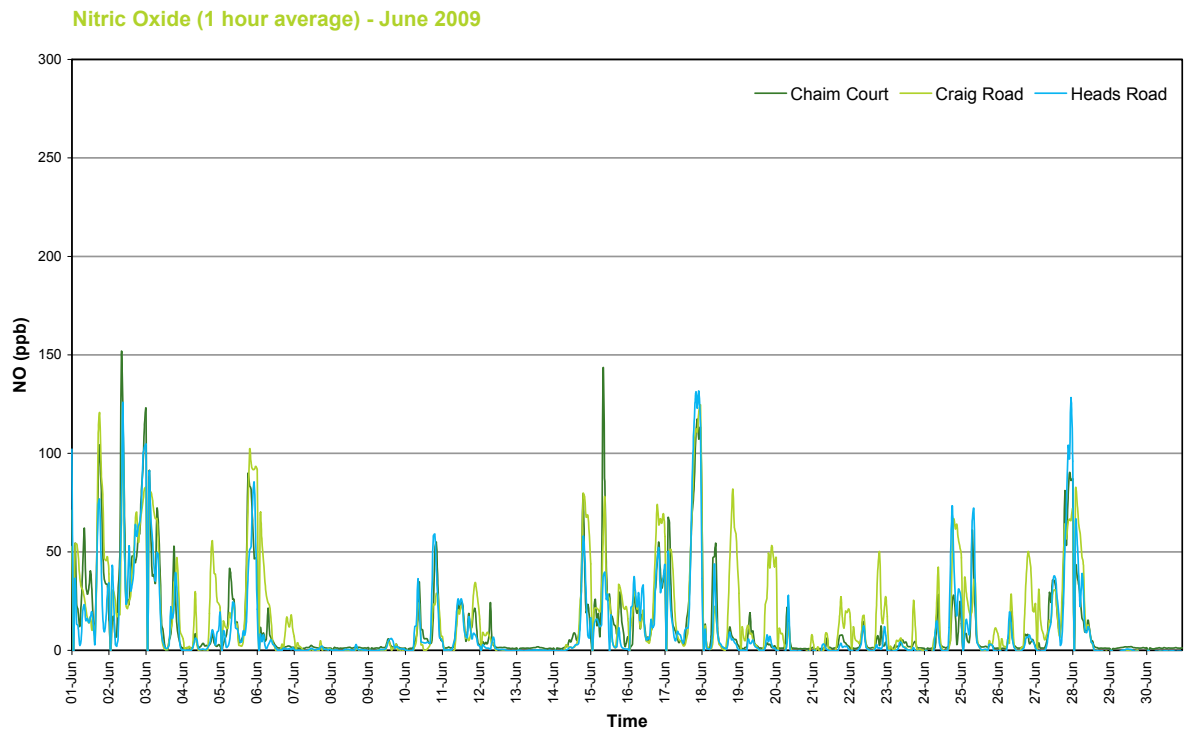


Figure 30: Nitric Oxide Concentration (1 Hour Average)

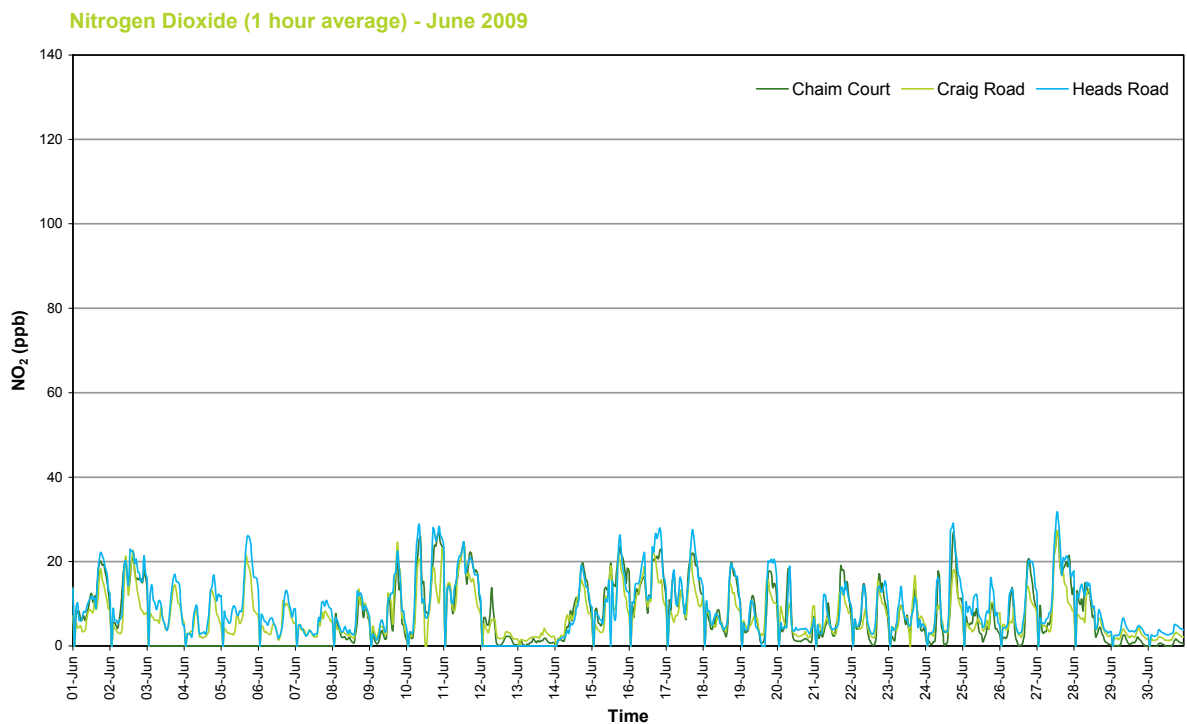


**8.3.2.2 Nitrogen Dioxide**

Nitrogen dioxide (1-hour average) concentration statistics for the reporting period are given in Table 41. A plot of nitrogen dioxide (1-hour average) concentration for the reporting period is presented in Figure 31.

**Table 41: Nitrogen Dioxide Concentration Percentiles (1 Hour Average)**

Station	Nitrogen Dioxide Concentration (ppb) (1-Hour Average)						
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>
Chaim Crt	27	25	24	21	19	14	6.9
Craig Rd	27	23	21	18	15	10	6.2
Heads Rd	32	28	27	23	20	14	8.6



*Figure 31: Nitrogen Dioxide Concentration (1 Hour Average)*



## 8.4 Meteorological Data

Wind speed and direction for each of the monitoring stations are presented as wind roses in Figures 32 – 34.

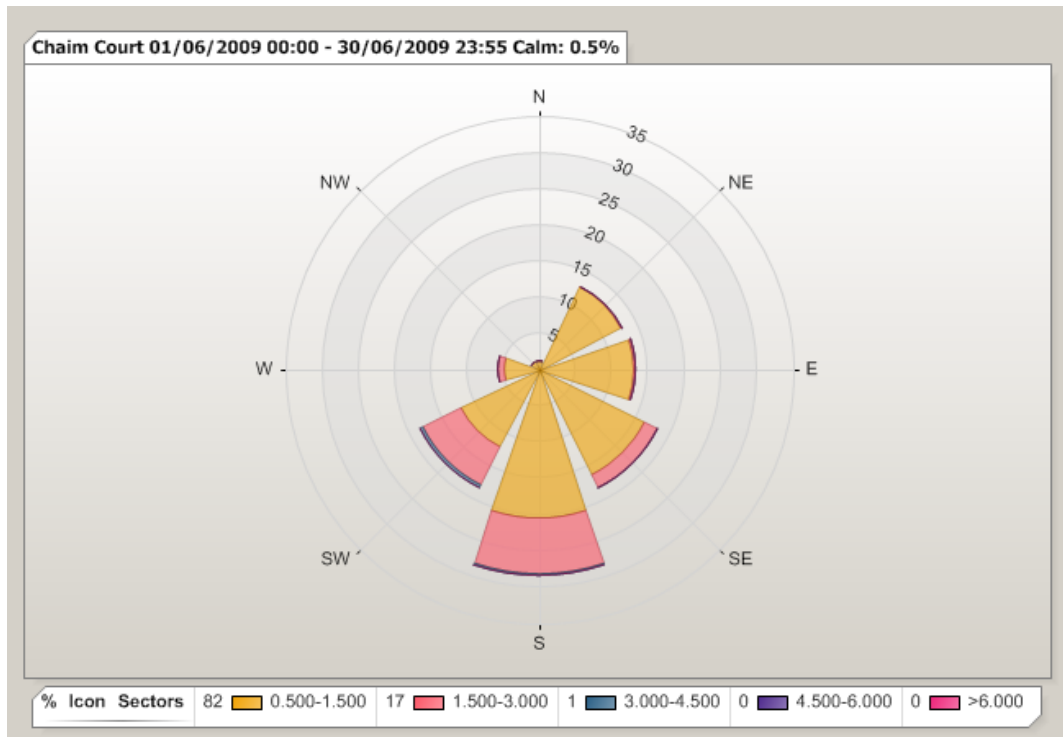


Figure 32: Chaim Court Wind Rose

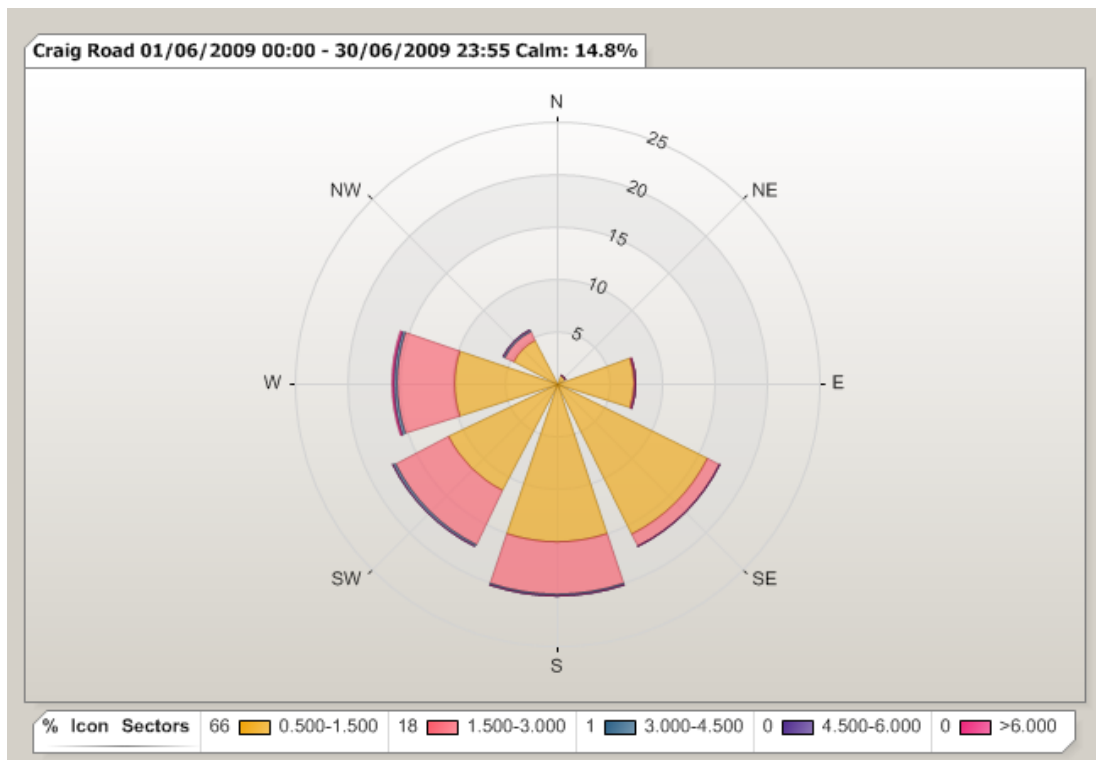


Figure 33: Craig Road Wind Rose



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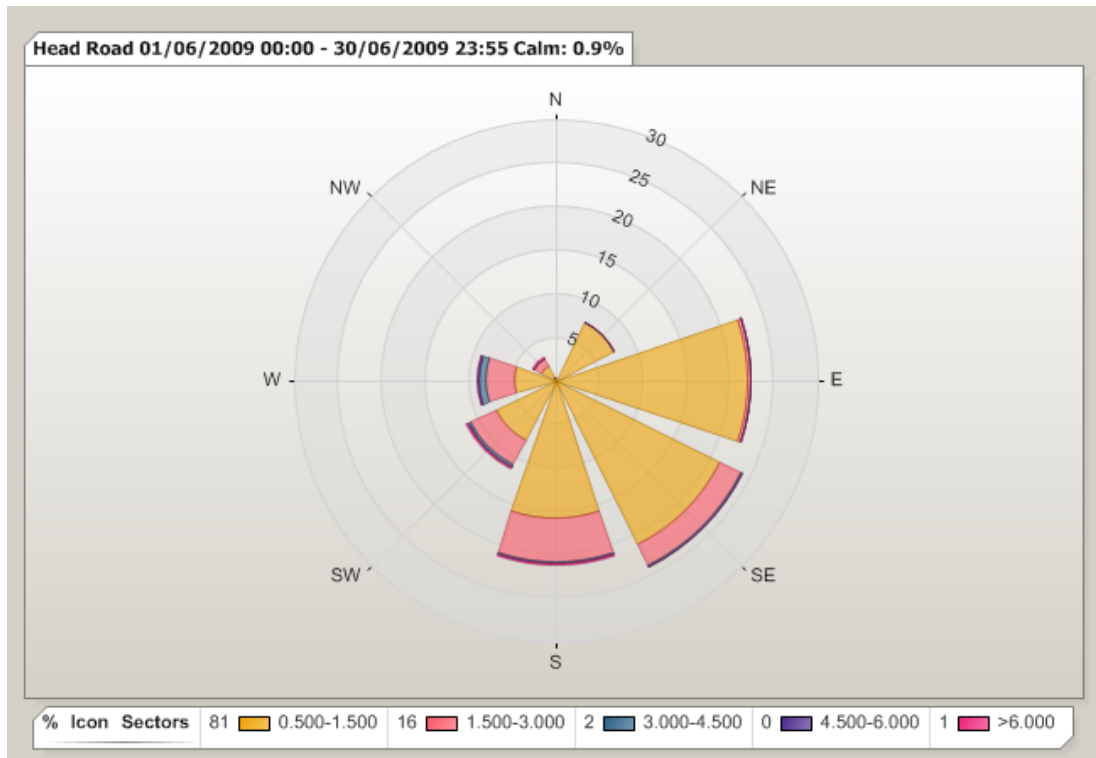


Figure 34: Heads Road Wind Rose



## 8.5 Data Validation and Exception

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 42 – 44 list the data exceptions for Chaim Court, Craig Road and Heads Road monitoring stations respectively. Data during automatic calibrations of the gaseous analysers has also been removed from the data sets.

**Table 42: Data Exceptions - Chaim Court**

Start	End	Parameter	Reason
3/06/2009 1:40	8/06/2009 0:55	NO <sub>2</sub> , NO <sub>x</sub>	Invalid data - Zero drift <sup>1</sup>
3/06/2009 14:40	3/06/2009 15:55	CO	Maintenance/calibration
3/06/2009 13:15	3/06/2009 16:40	PM <sub>10</sub>	Maintenance/calibration
3/06/2009 13:25	3/06/2009 17:20	PM <sub>2.5</sub>	Maintenance/calibration

**Table 43: Data Exceptions - Craig Road**

Start	End	Parameter	Reason
10/06/2009 12:40	10/06/2009 13:05	CO	Maintenance/calibration
10/06/2009 12:40	10/06/2009 14:00	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
10/06/2009 12:30	10/06/2009 14:45	PM <sub>10</sub>	Maintenance/calibration
23/06/2009 14:35	23/06/2009 15:05	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration

**Table 44: Data Exceptions - Heads Road**

Start	End	Parameter	Reason
12/06/2009 3:00	14/06/2009 1:40	NO <sub>2</sub> , NO <sub>x</sub>	Invalid data - span drift <sup>1</sup>
15/06/2009 11:55	15/06/2009 12:30	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
19/06/2009 14:40	19/06/2009 16:05	CO	Maintenance/calibration
19/06/2009 14:40	19/06/2009 16:30	NO, NO <sub>2</sub> , NO <sub>x</sub>	Maintenance/calibration
23/06/2009 15:30	23/06/2009 18:05	PM <sub>10</sub>	Maintenance/calibration
24/06/2009 15:40	24/06/2009 17:20	PM <sub>10</sub>	Maintenance/calibration

<sup>1</sup> In the opinion of the data reviewer.





## 9.0 DISCUSSION

### 9.1 Comparison with Air Quality Objectives

#### 9.1.1 PM<sub>2.5</sub> and PM<sub>10</sub>

Assessment criteria for PM<sub>2.5</sub> and PM<sub>10</sub> are taken from the State Environment Protection Policy (Air Quality Management) (SEPP {AQM}) Schedule B intervention levels. The intervention levels for PM<sub>10</sub> and PM<sub>2.5</sub> are as follows:

- PM<sub>10</sub> (24-hour) 60 µg/m<sup>3</sup>;
- PM<sub>2.5</sub> (24 hour) 36 µg/m<sup>3</sup>.

There were four exceedence days of the PM<sub>2.5</sub> intervention level during the reported period. Exceedences occurred on 22/04/2009, 23/04/2009, 21/05/2009 and 22/05/2009. The maximum 24-hour average PM<sub>2.5</sub> concentration was 54 µg/m<sup>3</sup> on 21/05/2009 at Chaim Court monitoring station.

There were no exceedence days of the PM<sub>10</sub> intervention level during the reported period. The maximum 24-hour average PM<sub>10</sub> concentration was 56 µg/m<sup>3</sup> on 23/04/2009 at Heads Road monitoring station.

#### 9.1.2 Nitrogen Dioxide

The assessment criterion for NO<sub>2</sub> is taken from the SEPP (AQM) Schedule B intervention level. The intervention level for NO<sub>2</sub> is as follows:

- NO<sub>2</sub> (1 hour) 140 ppb.

There were no exceedences of the NO<sub>2</sub> intervention level during the reported period at any of the monitoring stations. The maximum 1-hour average NO<sub>2</sub> concentration was 38 ppb on 22/04/2009 19:00 hours at Chaim Court monitoring station.

#### 9.1.3 Carbon Monoxide

Assessment criteria for CO are taken from the (SEPP AQM) Schedule B intervention level and the State Environment Protection Policy (Ambient Air Quality) {SEPP (AAQ)} air quality objective. The intervention and SEPP (AAQ) levels for CO are as follows:

- CO (1 hour) 29 ppm {SEPP (AQM)};
- CO (8-hour) 9 ppm {SEPP (AAQ)}.

There were no exceedences of the CO intervention level or SEPP (AAQ) objective during the reported period at any of the monitoring stations. The maximum 1-hour average CO concentration was 2.3 ppm on 22/05/2009 09:00 hours at Chaim Court monitoring station. The maximum 8-hour average CO concentration was 1.9 ppm on 20/05/2009 01:00 hours reported at the Craig Road monitoring station.

### 9.2 Data Capture Year to Date

2009 data capture statistics for the period 01/01/2009 to 30/06/2009 are presented in Table 45.



**Table 45: Data Capture - Year to Date**

STATION	DATA CAPTURE STATISTICS % YEAR TO DATE (01/01/2009 – 30/06/2009)			
	PM <sub>2.5</sub>	PM <sub>10</sub>	NO <sub>x</sub>	CO
Chaim Crt	97.3	99.6	94.4	97.0
Craig Rd		99.6	96.3	96.5
Heads Rd		99.1	95.4	96.6



## Report Signature Page

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# **APPENDIX A**

## **Limitations**



## **LIMITATIONS**

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