

North Queensland Bulk Ports Corporation

McEwens Beach PM₁₀ Solar BAM1020 & PM_{2.5} Solar E-sampler

Ambient Air Quality Monitoring

Validated Report

1st April 2017 – 30th April 2017

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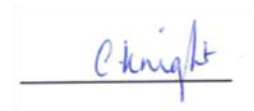
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North Queensland Bulk Ports Corporation

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Executive Summary

North Queensland Bulk Ports Corporation has commissioned Ecotech P/L to conduct air quality monitoring for the vicinity of the Port of Hay Point at McEwens Beach. The McEwens Beach monitoring station is currently comprised of a Solar BAM1020 and a solar E-Sampler equipped to measure PM₁₀ and PM_{2.5} respectively. A wind sensor is also installed at the air quality station.

The air quality station was commissioned in March 2013.

This report presents the data collected from the McEwens Beach station during the month of April 2017.

Data capture for PM₁₀ and PM_{2.5} was 51.3% and 100.0% respectively for the reporting period. Data capture for wind speed and direction was 100.0%.

No exceedances were recorded for PM₁₀ or PM_{2.5} during the month.

The PM₁₀ monthly average was 15 µg/m³ with a standard deviation of 13 µg/m³. The PM_{2.5} monthly average was 5 µg/m³ with a standard deviation of 4 µg/m³.

1.0 Introduction

Ecotech Pty Ltd was commissioned by North Queensland Bulk Ports Corporation to provide monitoring and data reporting for the McEwens Beach ambient air quality monitoring station, located as detailed in Table 1. Ecotech commenced data collection from the McEwens Beach station on the 4th (Solar E-Sampler PM_{2.5}) and 5th (Solar BAM PM₁₀) April 2013.

This report presents the data from the Solar BAM and Solar E-Sampler for April 2017.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

2.0 Monitoring and Data Collection

2.1. Siting Details

The McEwens Beach consists of one ambient air quality monitoring station. The station's location and siting details are described below.

Table 1: McEwens Beach monitoring site location

Site Name	Geographical Coordinates	Height Above Sea Level (m)
McEwens Beach	Lat: -21.249444° Long: 149.206389°	6

A siting audit was conducted by Ecotech Pty Ltd on 5th January 2017 to assess compliance with AS/NZS 3580.1.1:2016 Methods for sampling and analysis of ambient air. The location was found to be compliant with the standard, with the exception of a road being located within 50m of the station. Given that this road is known to only be lightly trafficked, and the airflow in the vicinity of the sampling inlet is maintained free from restrictions independent of this proximity, these factors are not likely affect sampling results and therefore the siting of the monitoring unit is considered to be in compliance with the intent of the Standards.



Figure 1: McEwens Beach Monitoring Station Location

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2.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at the McEwens Beach monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the McEwens Beach monitoring station

Parameter Measured	Instrument and Measurement Technique
PM ₁₀	Met One BAM 1020 – Beta ray attenuation
PM _{2.5}	Met One E-Sampler – light scatter aerosol monitor
Wind Speed (horizontal, elevation 3 m)	Met One 034B – cup and vane
Wind Direction (elevation 3 m)	Met One 034B – cup and vane

2.3. Data Collection Methods

Table 3 shows the methods used for data collection. Any deviations from the stated methods are detailed in section 2.3.1.

Table 3: Methods

Parameter Measured	Data Collection Methods Used	Description of Method
PM ₁₀ (BAM 1020)	AS 3580.9.11-2008	Methods of sampling and analysis of ambient air. Method 9.11: Determination of suspended particulate matter – PM ₁₀ beta attenuation monitors
	Ecotech Laboratory Manual	In-house method 7.5 – Measurement of PM ₁₀ , PM _{2.5} and TSP using Beta Attenuation Monitor.
PM _{2.5} (E-Sampler)	Met One E-Sampler Operation Manual	Met One E-Sampler Operation Manual
Vector Wind Speed (Horizontal)	AS 3580.14 2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Ecotech Laboratory Manual	In-house method 8.1 Wind speed (Horizontal) by anemometer
Vector Wind Direction	AS 3580.14 2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Ecotech Laboratory Manual	In-house method 8.3 Wind direction by anemometer

2.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the McEwens Beach station according to the methods detailed in Table 3.

- Measurement of wind speed and direction is not covered by Ecotech’s NATA scope of accreditation as the sensor has not been calibrated in accordance with the requirements of AS 3580.14.2014. The sensor does not meet the performance specifications of AS 3580.14.2014
- Measurement of PM_{2.5} by E-Sampler is not covered by Ecotech’s NATA scope of accreditation.
- The monitoring location is not fully compliant with AS/NZS 3580.1.1-2007 as detailed in section 2.1.

2.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. The logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the WinAQMS logger on a daily basis (using Airodis™ version 5.1.0) and stored at Ecotech’s Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals for the E-Sampler and hourly for the BAM1020.

2.4. Data Validation and Reporting

2.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc) in the database for flagging any data as invalid.

Validation is performed by the Ecotech ERS operator, and the validation is reviewed. All data is checked and graphs and reports are generated based on the verified five minute data for the E-Sampler and on the hourly data for the BAM1020.

2.4.2. Reporting

The reported data is in a Microsoft Excel format file named “NQBP McEwens Beach Data Report April 2017.xls”.

The Excel file consists of six worksheets:

1. Cover
2. 5 Min Averages
3. 15 Min Averages
4. 1 Hour Averages
5. 24 Hour Averages
6. Valid Data Exception Tables

The data contained in these reports is based on Australian Eastern Standard Time. Data is for all parameters measured continuously.

All averages are calculated from the five minute data for the E-Sampler and from hourly data for the BAM1020. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00am is for the data collected from 1:00am to 2:00am. One hour averages are calculated based on a clock hour. One day and one year averages are calculated based on calendar days.

Wind Data Reporting

Wind speed, wind speed gust and wind direction data associated with calm wind conditions are reported in accordance with the requirements of AS 3580.14-2014 Method for sampling and analysis of ambient air – Meteorological monitoring for ambient quality monitoring applications. Calm wind conditions are defined as wind speeds below the starting threshold of the wind speed / direction sensors. Sensor starting thresholds are given in Table 5 under “Measurement Range”.

In this report, calm wind speed and wind speed gust readings in tabulated data are reported as 0 m/s. Wind direction readings during calm periods are excluded from the tabulated data (reported as nulls).

Calm readings are excluded from wind roses; however the percentage of calm data is indicated at the bottom of the graph. In all other graphic representations of the data, wind speed, gust and direction values are reported as logged, without calm filters applied.

3.0 Air Quality Goals

The air quality goals for pollutants monitored at the McEwens Beach Station monitoring network site are based on the Australian National Environmental Council (NEPC) Ambient Air Quality NEPM. The air quality goals are shown in Table 4 below.

Table 4: McEwens Beach Air Quality Goals

Parameter	Time Period	Exceedance Level	Units	Maximum allowable exceedances
PM ₁₀	1 day	50	µg/m ³	None
PM ₁₀	1 year	25	µg/m ³	None
PM _{2.5}	1 day	25	µg/m ³	None
PM _{2.5}	1 year	8	µg/m ³	None

Note:

Exceptional events are excluded from this standard. As per the Ambient Air Quality NEPM, **Exceptional event** means a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1 day average standards in excess of normal historical fluctuations and background levels, and is directly related to: bushfire; jurisdiction authorised hazard reduction burning; or continental scale windblown dust.

Ecotech will include any valid data identified as being associated with an exceptional event in all report tables and graphic representations. However 1 day averages associated with exceptional events will not be counted as exceedances of the Air Quality standard.

4.0 Calibrations and Maintenance

4.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer’s tolerance limits of the equipment’s parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

Table 5: Units and Uncertainties

Parameter	Units	Resolution	Uncertainty	Measurement Range ¹
PM ₁₀ (BAM 1020)	µg/m ³	1 µg/m ³	± 5 µg/m ³ or 5.4% of reading, whichever is greater k=2.01 ²	0 to 1000 µg/m ³
PM _{2.5} (E-Sampler)	µg/m ³	1 µg/m ³	± 10% to gravimetric method ³ K factor of 1.32	0 to 65,530 µg/m ³
Vector Wind Speed	m/s	0.1 m/s	±0.22 m/s or 3.0% of reading, whichever is greater K factor of 1.96	0.4 m/s to 15 m/s
Vector Wind Direction	Deg	1 deg	±4 deg K factor of 2.11	0 deg to 360 deg Starting threshold: 0.4 m/s

¹ Uncertainties may not be calculated based on the full measurement range.

² Quoted uncertainty relates to hourly readings

³ Manufacturer’s stated accuracy for nephelometer when calibrated for local particulate type.

4.2. Maintenance

Scheduled maintenance is completed quarterly by Ecotech for the BAM1020, E-sampler and Wind Sensor. E-Sampler maintenance for the intervening months is completed by a customer-nominated third party.

4.2.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to verification, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 6 indicates when the particulate and meteorological equipment were last maintained/calibrated.

Table 6: McEwens Beach Maintenance Table April 2017

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration
PM ₁₀	13/04/2017	Unscheduled	11/04/2017
PM _{2.5}	14/03/2017	2 Monthly, 6 Monthly	14/03/2017
Wind Speed	24/03/2017	6 Monthly	05/01/2017
Wind Direction	24/03/2017	6 Monthly	05/01/2017

*Note: wind sensor date of yearly maintenance refers to onsite calibration.

5.0 Results

5.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:

$$\text{Data capture} = (\text{Reported air quality data} / \text{Total data}) \times 100\%$$

Where:

- Reported air quality data = Number of instrument readings which have been verified through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 7 below displays data capture statistics for April 2017. **Bold** values in the table indicate data capture below 95%.

Table 7: Monthly Data Capture for McEwens Beach Station Site for April 2017

Parameter	Data Capture (%)
PM ₁₀	51.3
PM _{2.5}	100.0
WS, WD	100.0

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5.2. Air Quality Summary

Table 8 below summarises any exceedances of the air quality goals recorded in the month of December 2016.

Table 8: Exceedances Recorded for April 2017

Parameter	Time Period	Value of Exceedance ($\mu\text{g}/\text{m}^3$)	Date of Exceedance
PM _{2.5}	24 Hour	No exceedance	N/A
PM ₁₀	24 Hour	No exceedance	N/A

Table 9 below presents some statistical parameters for April 2017. The standard deviation is calculated based on the hourly averaged data.

Table 9: General statistics for April 2017

Parameter	Time Period	Average ($\mu\text{g}/\text{m}^3$)	Standard Deviation ($\mu\text{g}/\text{m}^3$)
PM ₁₀	1 month	15	13
PM _{2.5}	1 month	5	4

5.3. Exceedances Discussion

- There were no exceedances over the PM_{2.5} limits during April 2017.
- There were no exceedances over the PM₁₀ limits during April 2017.

5.4. Tabulated Data

Table 10 details the daily averages for PM₁₀, PM_{2.5} and meteorological parameters measured at McEwens Beach station during April 2017.

Table 10: McEwens Beach Station Summary Data Table April 2017

Daily Data – PM ₁₀ , PM _{2.5} , WS, WD				
Date	PM _{2.5} (µg/m ³)	WS (m/s)	WD (deg)	PM ₁₀ (µg/m ³)
1/04/2017	4	0.7	125	
2/04/2017	5	1.7	127	
3/04/2017	6	3.4	119	
4/04/2017	8	4.0	116	
5/04/2017	7	3.2	126	
6/04/2017	6	3.0	124	
7/04/2017	5	3.9	119	
8/04/2017	5	3.1	124	16
9/04/2017	5	2.3	123	12
10/04/2017	4	1.6	122	
11/04/2017	4	1.7	126	16
12/04/2017	4	1.7	127	
13/04/2017	6	2.7	118	
14/04/2017	5	2.4	120	11
15/04/2017	4	1.4	112	
16/04/2017	3	2.4	113	
17/04/2017	4	3.5	111	
18/04/2017	4	4.0	116	
19/04/2017	5	4.4	120	
20/04/2017	7	4.9	120	
21/04/2017	7	3.5	120	23
22/04/2017	5	3.7	120	20
23/04/2017	5	2.8	122	16
24/04/2017	4	2.1	120	17
25/04/2017	4	1.1	109	13
26/04/2017	3	0.5	348	10
27/04/2017	3	1.8	115	10
28/04/2017	2	1.5	147	10
29/04/2017	3	1.1	139	9
30/04/2017	10	2.0	120	24

5.5. Graphic Representations

Validated data for PM₁₀, PM_{2.5}, WS and WD were used to construct the following monthly graphic representations.

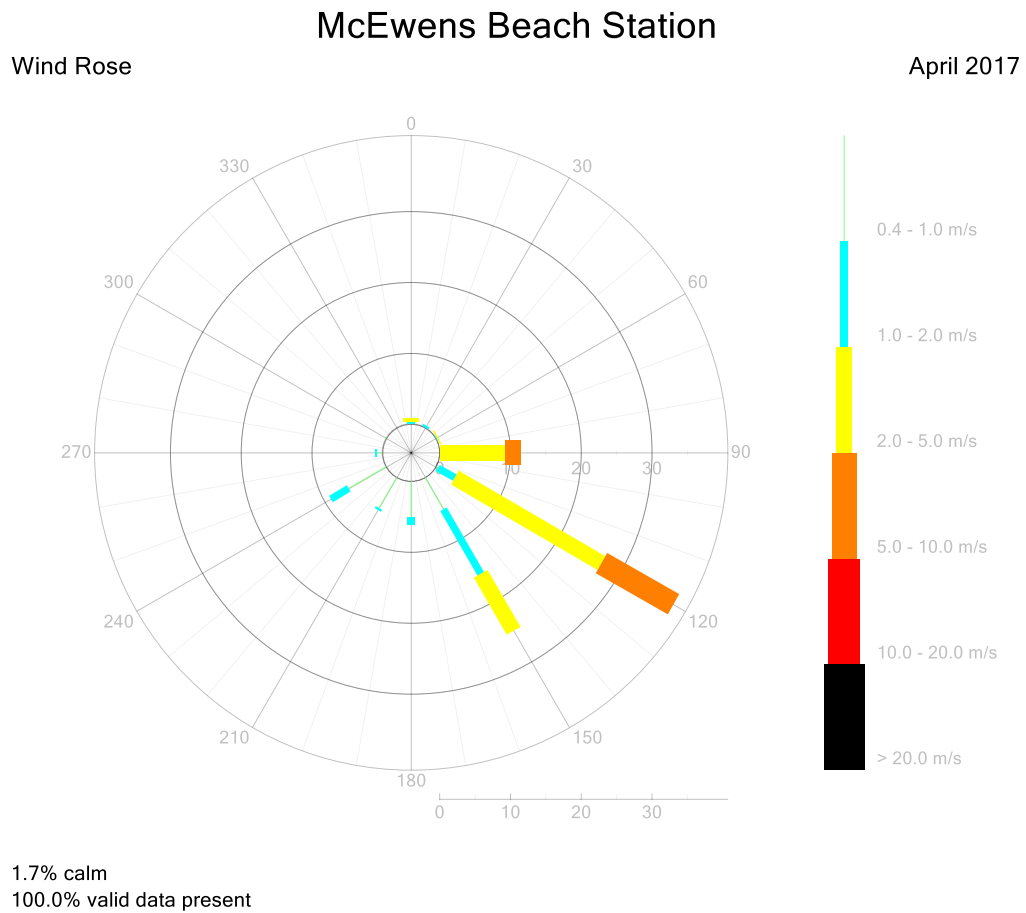


Figure 2: Wind Rose for McEwens Beach station (1-hour average) – April 2017

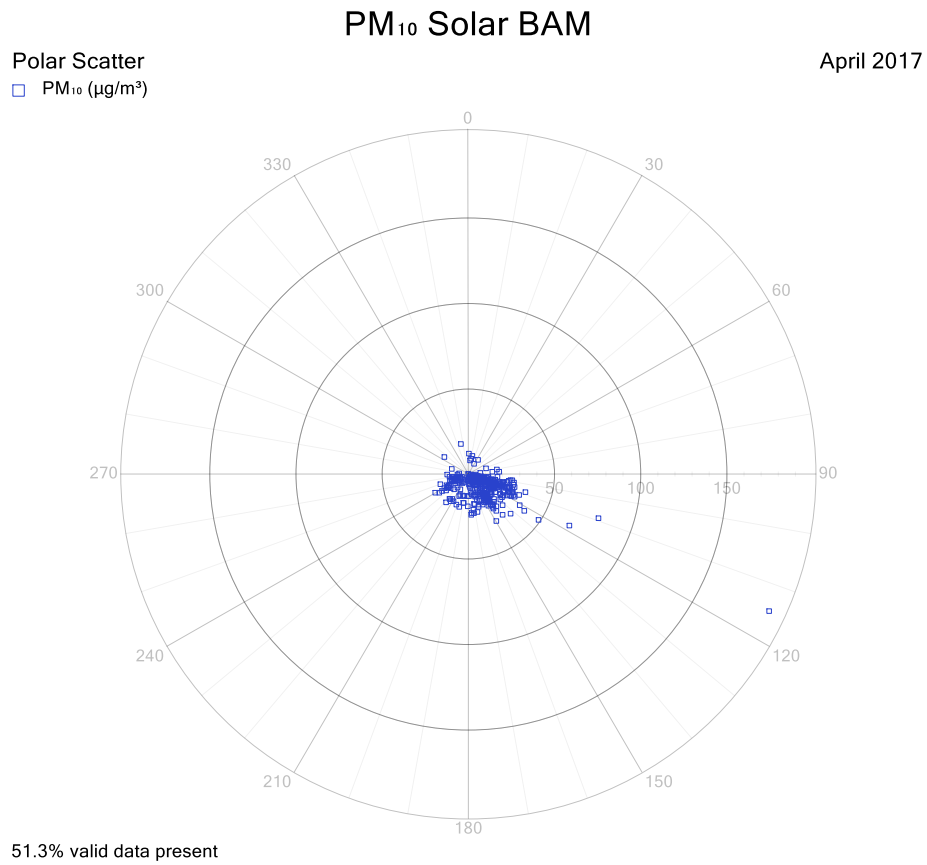


Figure 3: PM₁₀ polar scatter plot (1-hour average) for McEwens Beach station –April 2017

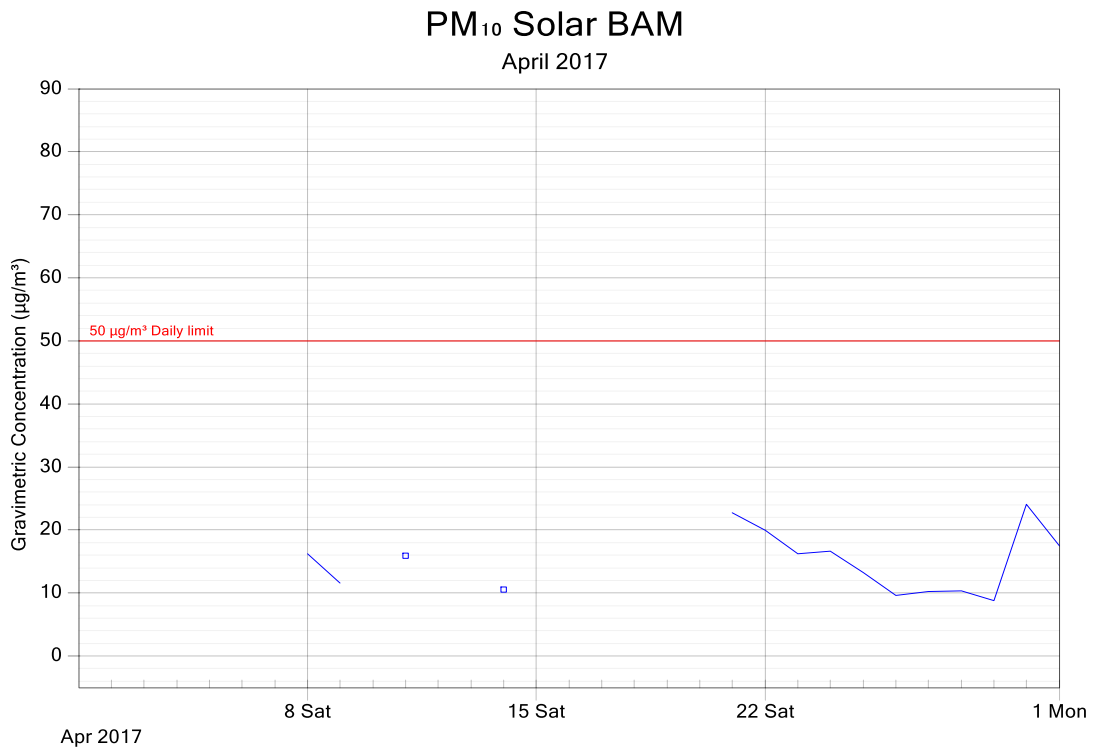


Figure 4: PM₁₀ for McEwens Beach station 24-hour Averages – April 2017

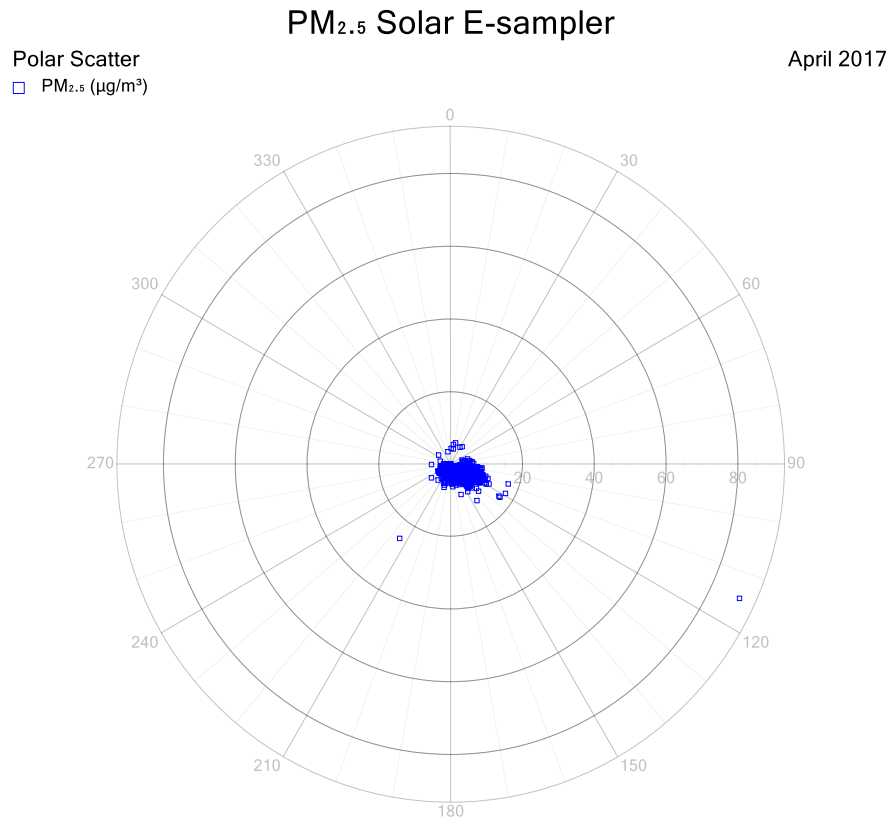


Figure 5: PM_{2.5} polar scatter plot (1-hour average) for McEwens Beach station – April 2017

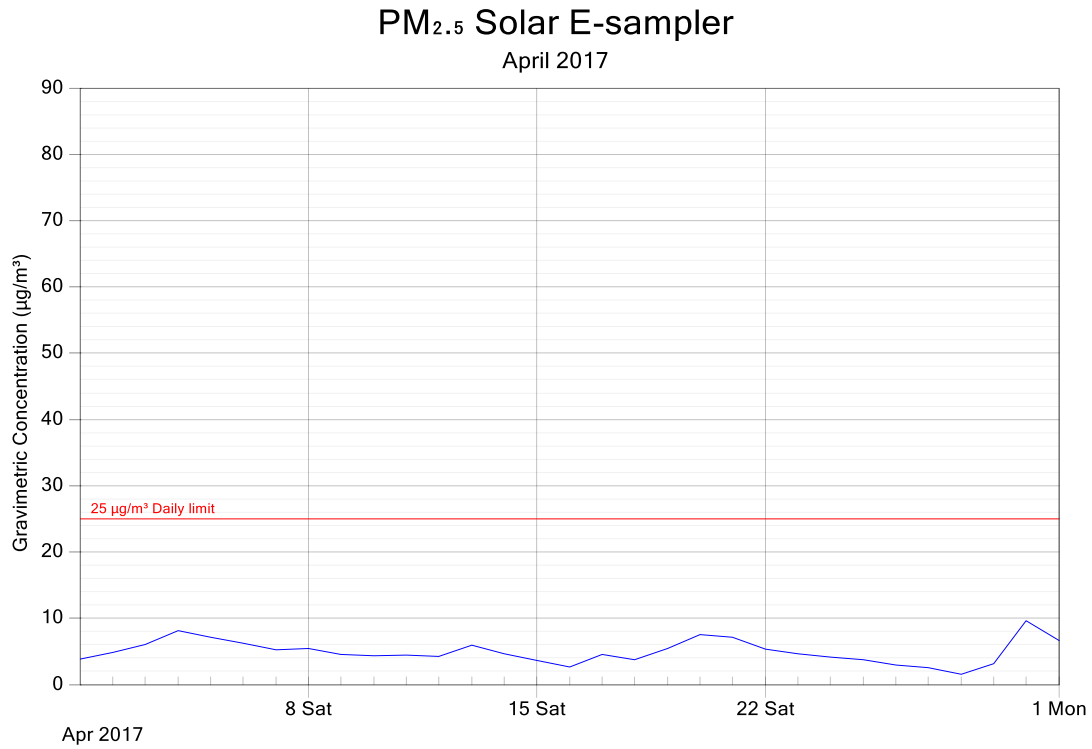


Figure 6: PM_{2.5} for McEwens Beach station 24-hour Averages – April 2017

6.0 Valid Data Exception Tables

The tables below detail all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

Table 11: McEwens Beach Solar BAM Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/04/2017 00:00	20/04/2017 12:00	Intermittent tape alarm	PM ₁₀	CK	15/05/2017
07/04/2017 14:00	07/04/2017 15:00	Unscheduled maintenance - station check following cyclone, tape break repaired	PM ₁₀	CK	15/05/2017
08/04/2017 00:00	29/04/2017 00:00	Intermittent beta count alarm	PM ₁₀	CK	15/05/2017
10/04/2017 13:00	10/04/2017 16:00	Unscheduled maintenance - BAM replacement, 3 monthly and yearly maintenance tasks	PM ₁₀	CK	15/05/2017
11/04/2017 11:00	11/04/2017 11:00	BAM parameter checks following instrument replacement	PM ₁₀	CK	15/05/2017
13/04/2017 10:00	13/04/2017 11:00	Unscheduled maintenance - tape break repaired	PM ₁₀	CK	15/05/2017

Table 12: McEwens Beach Solar E-Sampler Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/04/2017 00:00	30/04/2017 23:55	No data invalidated	PM _{2.5}	CK	15/05/2017

7.0 Report Summary

- Data capture for PM₁₀ was 51.3% during April 2017 due to intermittent beta count errors and a tape faults occurring during the month.
- Data capture for PM_{2.5} was 100.0% for April 2017.
- Data capture for wind speed and direction was 100.0% for April 2017.
- No exceedances were recorded for PM₁₀ or PM_{2.5}.
- The PM₁₀ monthly average was 15 µg/m³ with a standard deviation of 13 µg/m³.
- The PM_{2.5} monthly average was 5 µg/m³ with a standard deviation of 4 µg/m³.
- Some data in this report does not comply with Australian Standard requirements and is not covered by Ecotech's NATA scope of accreditation. Refer to section 2.3.1 for further details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

$\mu\text{g}/\text{m}^3$	Micrograms per cubic metre at standard temperature and pressure (0°C and 101.3 kPa)
calm	Wind conditions where the wind speed is below the operating range of the wind sensor
deg	Degrees (True North)
m/s	Metres per second
PM ₁₀	Particulate less than 10 microns in equivalent aerodynamic diameter
PM _{2.5}	Particulate less than 2.5 microns in equivalent aerodynamic diameter
WD	Vector Wind Direction
WS	Vector Wind Speed

Appendix 2 - Explanation of Exception Table

Commissioning refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

Data affected by environmental conditions – wind speed/wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

Data transmission error refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

Equipment malfunction/instrument fault refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

Gap in data/data not available refers to a period of time when either data has been lost or could not be collected.

Instrument Alarm refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

Instrument out of service refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

Linear offset or multiplier refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

Logger error refers to when an error occurs and instrument readings are not correctly recorded by the logger.

Maintenance refers to a period of time when the logger/instrument was switched off due to maintenance.

Power Interruption refers to no power to the station therefore no data was collected at this time.

Tape break refers to the breaking of the EBAM/BAM sample tape during operation.

Warm up after power interruption refers to the startup period of an instrument after power has been restored.