

North Queensland Bulk Ports Corporation

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

Ambient Air Quality Monitoring Validated Report

1st July 2020 – 31st July 2020

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ECOTECH PTY LTD. ABN: 32005752081

1492 Ferntree Gully Rd, Knoxfield VIC. 3180. AUSTRALIA

Tel No: 1300 364 946 Fax No: 1300 668 763

Email ecotech@ecotech.com WEB www.ecotech.com

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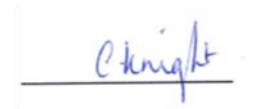
Report No: DAT16120

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Customer Details	
Customer	North Queensland Bulk Ports Corporation
Contact name	Vanessa Boettcher
Address	Level 1, 324 Queen Street, Brisbane QLD 4000
Email	vboettcher@nqbp.com.au
Phone	07 4955 8105

Revision History			
Revision	Report ID	Date	Analyst
0	DAT16120	27/08/2020	Caroline Knight

Report by: Caroline Knight



Signatory: Jon Alexander



Report No: DAT16120

North Queensland Bulk Ports Corporation

Table of Contents

Customer Details.....	2
Revision History	2
Table of Contents.....	3
List of Figures	4
List of Tables	5
Executive Summary.....	6
1.0 Introduction	7
2.0 Monitoring and Data Collection.....	7
2.1. Siting Details.....	7
2.2. Monitored Parameters	9
2.3. Data Collection Methods	10
2.3.1. NATA endorsement and Conformity with Standards	11
2.3.2. Data Acquisition	11
2.4. Data Validation and Reporting.....	12
2.4.1. Validation	12
2.4.2. Reporting.....	12
3.0 Target Maximum Exceedences	14
4.0 Calibrations and Maintenance.....	15
4.1. Units and Uncertainties	15
4.2. Maintenance	16
4.2.1. Calibration & Maintenance Summary Tables	16
5.0 Results.....	17

Report No: DAT16120

North Queensland Bulk Ports Corporation

5.1.	Data Capture	17
5.2.	Air Quality Summary	18
5.3.	Exceedences Discussion	18
5.4.	General Statistics	19
5.5.	Tabulated Data	20
5.6.	Graphic Representations	21
6	Valid Data Exception Tables	26
7	Report Summary	27
Appendix 1 - Definitions & Abbreviations.....		28
Appendix 2 - Explanation of Exception Table		29

List of Figures

Figure 1: McEwens Beach Monitoring Station Location	8
Figure 2: Wind Rose for McEwens Beach Station (1-Hour Average) – July 2020	21
Figure 3: PM ₁₀ Polar Scatter Plot (1-Hour Average) for McEwens Beach Station – July 2020.....	22
Figure 4: PM ₁₀ for McEwens Beach station 24-hour Averages – July 2020	23
Figure 5: PM _{2.5} Polar Scatter Plot (1-Hour Average) for McEwens Beach Station – July 2020	24
Figure 6: PM _{2.5} for McEwens Beach Station 24-hour Averages – July 2020	25

List of Tables

Table 1: McEwens Beach monitoring site location.....	7
Table 2: Parameters measured at the McEwens Beach monitoring station	9
Table 3: Methods	10
Table 4: Target Maximum Exceedences	14
Table 5: Units and Uncertainties.....	15
Table 6: McEwens Beach Maintenance Table July 2020	16
Table 7: Monthly Data Capture for McEwens Beach Station Site for July 2020.....	17
Table 8: Exceedences Recorded for July 2020	18
Table 9: General statistics for July 2020	19
Table 10: McEwens Beach Station Summary Data Table July 2020	20
Table 11: McEwens Beach Solar BAM Valid Data Exception Table.....	26
Table 12: McEwens Beach Solar E-Sampler Valid Data Exception Table.....	26

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 July 2020.

Data capture for PM₁₀ was 99.7% for July 2020.

Data capture for PM_{2.5} was 91.2% and 90.6% for wind speed and wind direction during July 2020. The low capture rate was due to frequent power interruptions caused by drops in solar battery voltage.

The PM₁₀ monthly average was 7 µg/m³ with a standard deviation of 10 µg/m³.

The PM_{2.5} monthly average was 4 µg/m³ with a standard deviation of 6 µg/m³.

There were no exceedences recorded for PM_{2.5} during July 2020.

There were no exceedences recorded for PM₁₀ during July 2020.

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 July 2020.

The data presented in this report:

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

2.0 Monitoring and Data Collection

2.1. Siting Details

The McEwens Beach site 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 8th January 2020 to assess station siting against the guidelines in *AS/NZS 3580.1.1:2016 Methods for sampling and analysis of ambient air*. The location was found to conform to the guidelines of 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 to affect sampling results and therefore the siting of the monitoring unit is considered to be in conformity with the intent of the Standard.

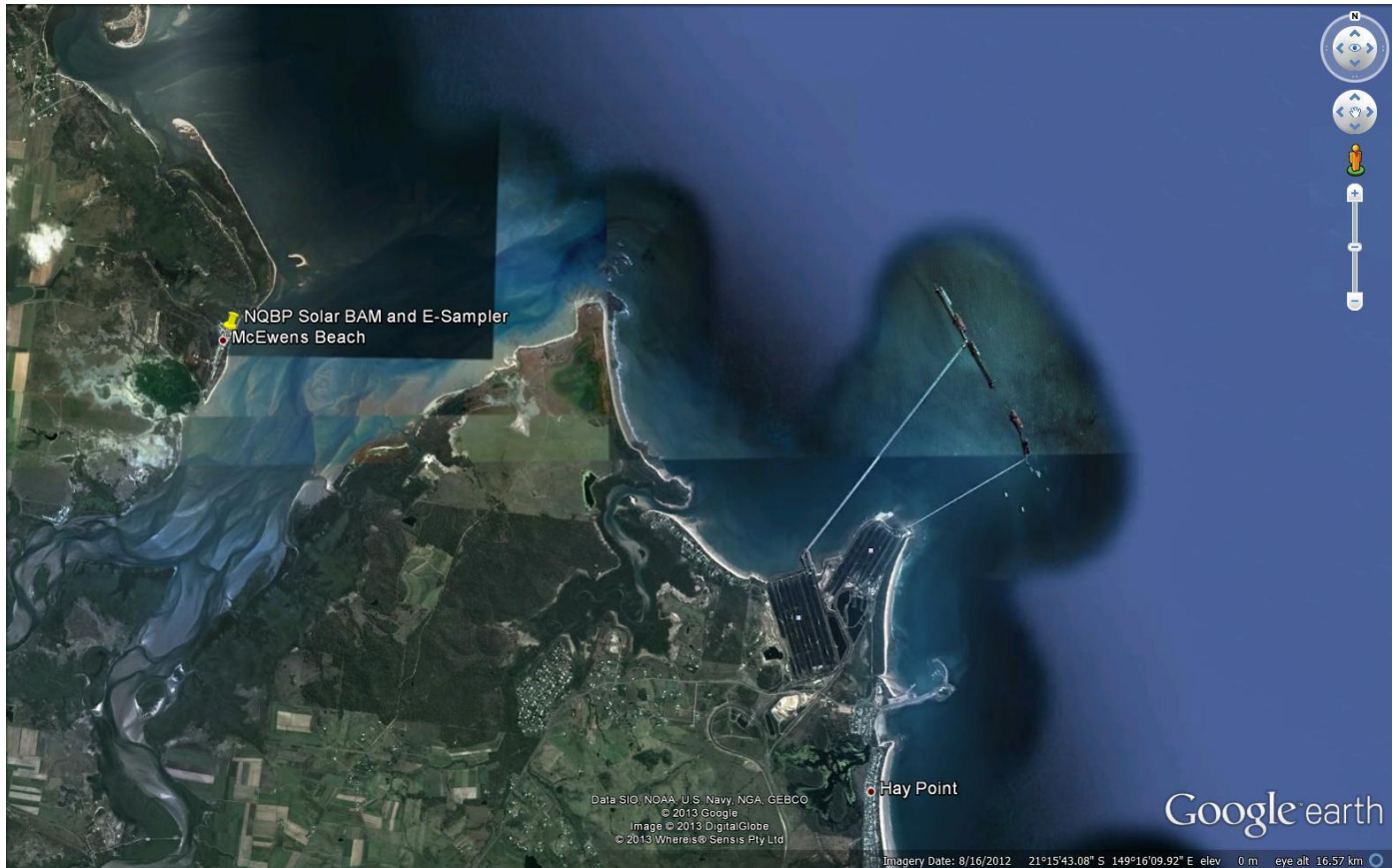


Figure 1: McEwens Beach Monitoring Station Location

Report No: DAT16120

North Queensland Bulk Ports Corporation

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

Report No: DAT16120

North Queensland Bulk Ports Corporation

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/NZS 3580.9.11 2016	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/NZS 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/NZS 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. NATA endorsement and Conformity 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 MetOne 034B sensor is not designed to meet the performance specifications of *AS/NZS 3580.14.2014*. However, the McEwens Beach site is considered a background site (as compared to a compliance site) and therefore the MetOne 034B sensor is deemed appropriate for this application.
- Measurement of PM_{2.5} by E-Sampler is not covered by Ecotech’s NATA scope of accreditation as there is currently no Australian Standard for the measurement of particulates via light scatter aerosol method. The McEwens Beach site is not considered a compliance site for the measurement of PM_{2.5} and the E-Sampler is therefore deemed to be an appropriate instrument for the purpose of providing a description of the ambient air quality in and around the Ports of Mackay and Hay Point.

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 5.1.5) 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 logged in hourly intervals 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 July 2020.xlsx”*.

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.

Report No: DAT16120

North Queensland Bulk Ports Corporation

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/NZS 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 Target Maximum Exceedences

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 target maximum exceedences are shown in Table 4 below.

Table 4: Target Maximum Exceedences

Parameter	Time Period	Exceedence Level	Units	Maximum Allowable Exceedences*
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

*Maximum allowable exceedences is a target. The site is not under operational control or formal compliance limits.

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 exceedence 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 exceedences of the Air Quality standard.

The measurement uncertainty (as outlined in Table 5) is not considered when assessing exceedences of the air quality goals. Exceedences are only reported for above goal values based on the decimal places reported.

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	24Hr: ± (5.5 % of reading + 4.0 µg/m ³) (in range 0 - 100 µg/m ³) Hr: ± (8 % of reading + 8.0 µg/m ³) k factor of 2.0	0 to 1000 µg/m ³ LDL _{24hr} =1.0µg/m ³ LDL _{hr} =4.8µg/m ³
PM _{2.5} (E-Sampler)	µg/m ³	1 µg/m ³	± 10% to gravimetric method ² K factor of 1.32	0 to 65 mg/m ³
Vector Wind Speed	m/s	0.1 m/s	±0.4 m/s or 2.0% of reading, whichever is greater K factor of 2.0	0.4 m/s to 15 m/s
Vector Wind Direction	Deg	1 deg	±4 deg K factor of 2.0	0 deg to 360 deg Starting threshold: 0.4 m/s

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

² Manufacturer’s stated accuracy for nephelometer when calibrated for local particulate type.

Report No: DAT16120

North Queensland Bulk Ports Corporation

4.2. Maintenance

Scheduled maintenance is completed quarterly by Ecotech for the BAM1020, E-sampler and Wind Sensor.

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 July 2020

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration
PM ₁₀	30/06/2020	Yearly	29/06/2020
PM _{2.5}	30/06/2020	3 Monthly	30/06/2020
Wind Speed	29/06/2020	3 Monthly	29/06/2020
Wind Direction	29/06/2020	3 Monthly	29/06/2020

*Note: wind sensor date of last calibration refers to date of last on site wind sensor check.

5.0 Results

5.1. Data Capture

BAM 1020 data capture is based on 1 hour averages. E-Sampler and wind data capture 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 samples (instrument readings) expected for the sampling period. Total data is calculated based on the same averaging period as “reported air quality data” and the duration of the corresponding report period. e.g. for 5 minute data collected over a month of 31 days, the total data would be equal to 12 (5 minute samples in an hour) x 24 (hours in a day) x 31 (days in a month) = 8928 samples.

Table 7 below displays data capture statistics for July 2020. **Bold** values in the table indicate data capture below 95%.

Table 7: Monthly Data Capture for McEwens Beach Station Site for July 2020

Parameter	Data Capture (%)
PM ₁₀	99.7
PM _{2.5}	91.2
WS, WD	90.6

- Data capture for PM_{2.5}, wind speed and wind direction fell below 95% due to frequent power interruptions caused by drops in solar battery voltage during the month.

Report No: DAT16120

North Queensland Bulk Ports Corporation

5.2. Air Quality Summary

Table 8 below summarises any exceedences of the air quality goals recorded in the month of July 2020.

Table 8: Exceedences Recorded for July 2020

Parameter	Time Period	Value of Exceedence ($\mu\text{g}/\text{m}^3$)	Date of Exceedence
PM _{2.5}	24 Hour	-	-
PM ₁₀	24 Hour	-	-

5.3. Exceedences Discussion

- There were no exceedences recorded for PM_{2.5} during July 2020.
- There were no exceedences recorded for PM₁₀ during July 2020.

Report No: DAT16120

North Queensland Bulk Ports Corporation

5.4 General Statistics

Table 9 below presents some statistical parameters for July 2020. The standard deviation is calculated based on the hourly averaged data.

Table 9: General statistics for July 2020

Parameter	Time Period	Average ($\mu\text{g}/\text{m}^3$)	Standard Deviation ($\mu\text{g}/\text{m}^3$)
PM ₁₀	1 month	7	10
PM _{2.5}	1 month	4	6

Report No: DAT16120

North Queensland Bulk Ports Corporation

5.5 Tabulated Data

Table 10 details the daily averages for PM₁₀, PM_{2.5} and meteorological parameters measured at McEwens Beach station during July 2020.

Table 10: McEwens Beach Station Summary Data Table July 2020

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)
1/07/2020	3	2.4	133	10
2/07/2020	3	1.3	125	6
3/07/2020	1	1.0	150	5
4/07/2020	8	0.9	145	21
5/07/2020	9	1.4	157	9
6/07/2020	8	1.3	160	9
7/07/2020	3	3.1	145	11
8/07/2020	4	3.9	137	10
9/07/2020	5	3.7	139	11
10/07/2020				7
11/07/2020				10
12/07/2020	3	0.3	26	5
13/07/2020	2	1.0	219	8
14/07/2020	0	0.7	151	4
15/07/2020	5	0.9	167	5
16/07/2020	4	0.6	152	6
17/07/2020	3	0.5	142	11
18/07/2020	5	0.3	245	9
19/07/2020	3	0.8	148	6
20/07/2020	3	0.3	126	4
21/07/2020	5	1.5	152	9
22/07/2020	5	2.4	157	10
23/07/2020	1	2.4	153	1
24/07/2020				4
25/07/2020				2
26/07/2020	2	0.8	326	2
27/07/2020	1	0.9	131	4
28/07/2020	1	0.4	182	4
29/07/2020	3	0.7	139	8
30/07/2020	2	1.4	145	5
31/07/2020	5	2.4	147	12

5.6 Graphic Representations

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

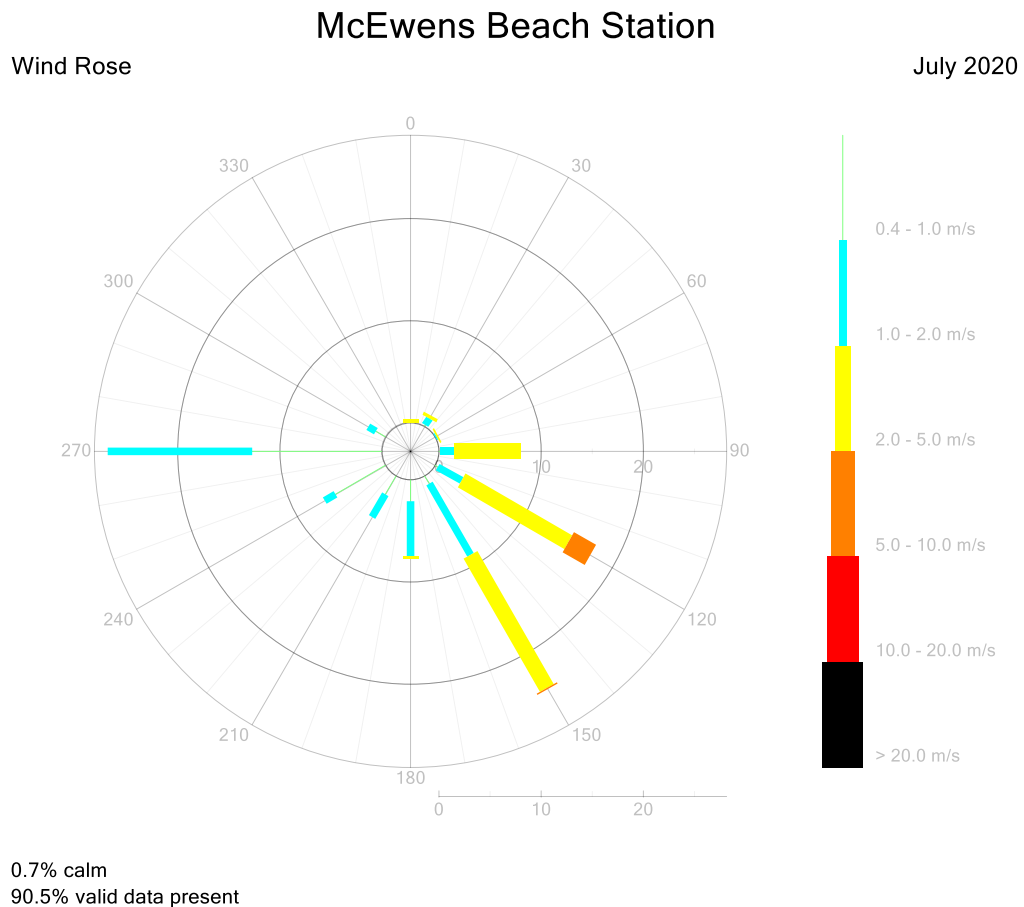


Figure 2: Wind Rose for McEwens Beach Station (1-Hour Average) – July 2020

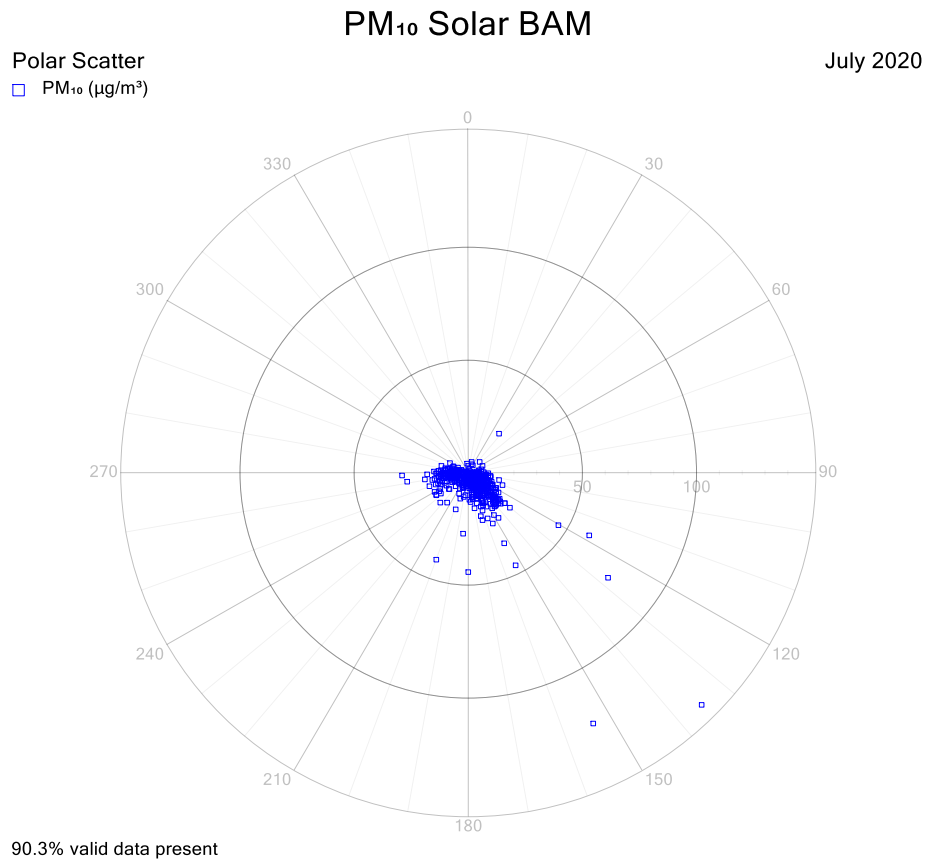


Figure 3: PM₁₀ Polar Scatter Plot (1-Hour Average) for McEwens Beach Station – July 2020

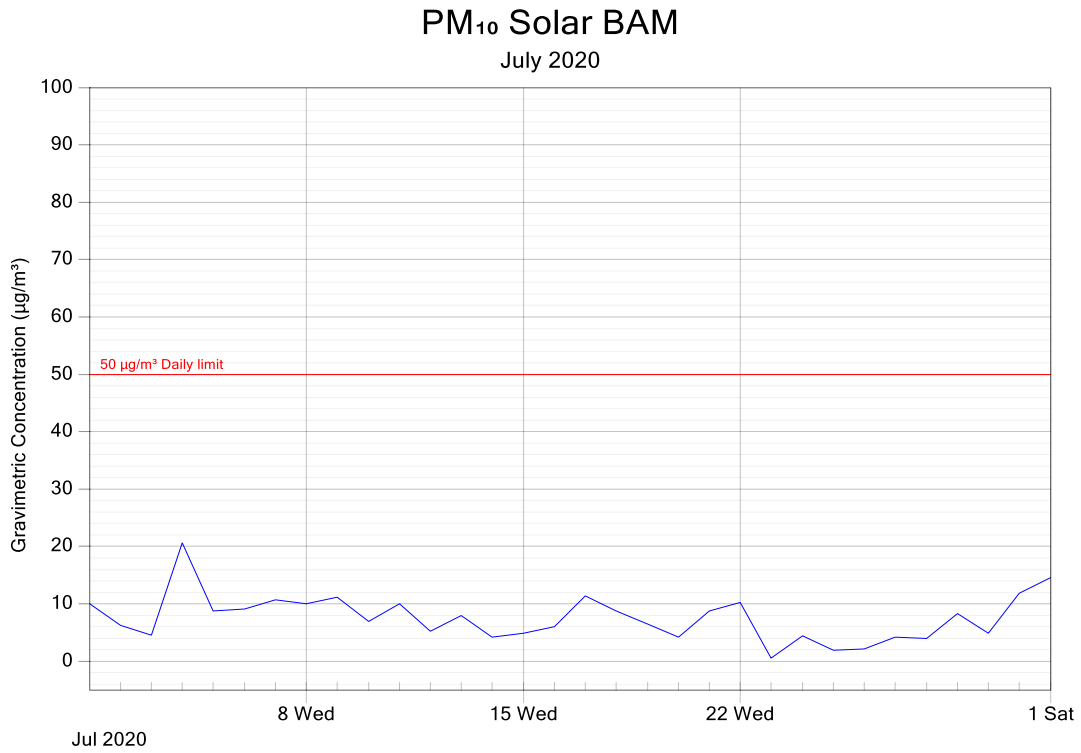


Figure 4: PM₁₀ for McEwens Beach station 24-hour Averages – July 2020

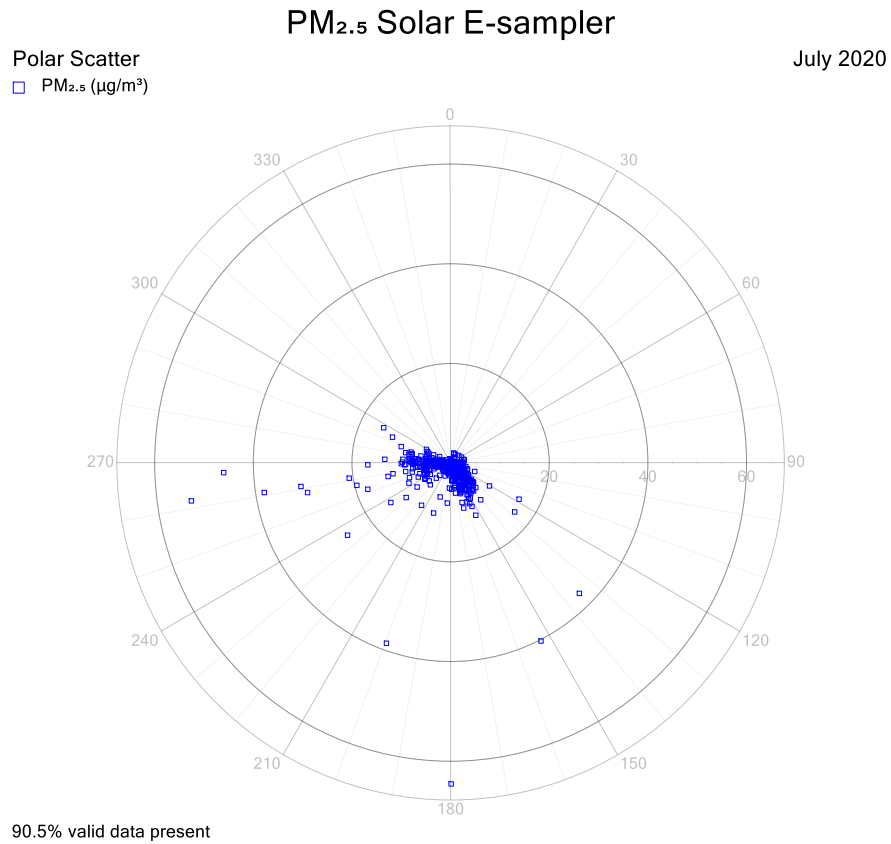


Figure 5: PM_{2.5} Polar Scatter Plot (1-Hour Average) for McEwens Beach Station – July 2020

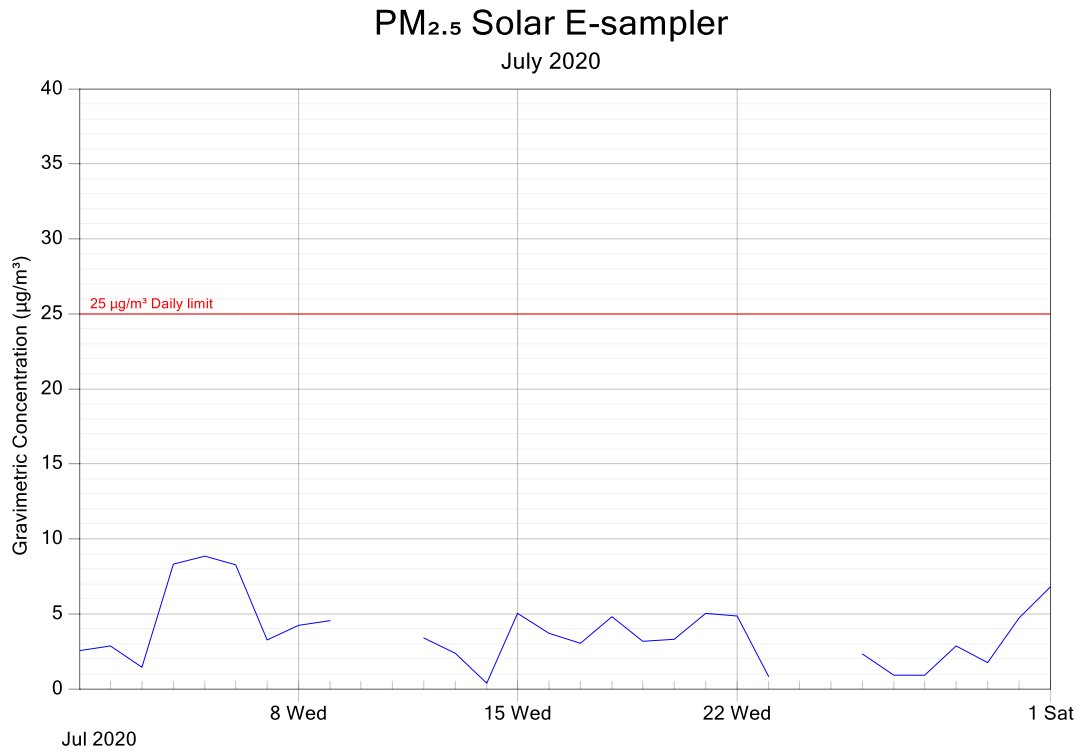


Figure 6: PM_{2.5} for McEwens Beach Station 24-hour Averages – July 2020

6 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
10/07/20 08:00	10/07/20 08:00	Brief data gap due to low solar charge	PM ₁₀	CK	27/08/20
14/07/20 21:00	14/07/20 21:00	Brief data gap due to low solar charge	PM ₁₀	CK	27/08/20

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

Start Date	End Date	Reason	Change Details	User Name	Change Date
10/07/20 05:10	11/07/20 10:30	Power interruption and instrument stabilisation due to low solar charge	All parameters	CK	27/08/20
12/07/20 19:15	13/07/20 00:05	Flatlined data	WS, WD	CK	27/08/20
14/07/20 08:00	14/07/20 08:00	Flow fault	PM _{2.5}	CK	27/08/20
17/07/20 18:00	17/07/20 18:00	Flow fault	PM _{2.5}	CK	27/08/20
23/07/20 21:30	25/07/20 09:10	Power interruption and instrument stabilisation due to low solar charge	All parameters	CK	27/08/20

Report No: DAT16120

North Queensland Bulk Ports Corporation

7 Report Summary

- Data capture for PM₁₀ was 99.7% for July 2020.
- Data capture for PM_{2.5} was 91.2% and 90.6% for wind speed and wind direction during July 2020. The low capture rate was due to frequent power interruptions caused by drops in solar battery voltage.
- The PM₁₀ monthly average was 7 µg/m³ with a standard deviation of 10 µg/m³.
- The PM_{2.5} monthly average was 4 µg/m³ with a standard deviation of 6 µg/m³.
- There were no exceedences recorded for PM_{2.5} during July 2020.
- There were no exceedences recorded for PM₁₀ during July 2020.
- Some data in this report does not conform to 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)
LDL	Lower Detectable Limit
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.

Stabilisation following power interruption refers to the start-up period of an instrument after power has been restored.

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