

# 2020 Annual Environmental Management Report

1 August 2019 - 31 July 2020

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30-Oct-2020

Job No.: 60613063

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## Quality Information

Document 2020 Annual Environmental Management Report


Ref 60613063

Date 30-Oct-2020

Prepared by James Enright / Nicholas Woodward

Reviewed by Paul Wenta

### Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	29-Oct-2020	Draft for client review	Cye Buckland Project Manager	
0	30-Oct-2020	Final	Cye Buckland Project Manager	

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## Table of Contents

1.0	Introduction	9
1.1	NCIA Background	9
1.1.1	Current Operations	9
1.1.2	Future Planned Operations	9
1.1.3	Historic and Current Production Volume	9
1.2	Regulatory Context	10
1.2.1	Current Approvals	10
1.2.2	AEMR Requirement	10
2.0	Standards and Performance Measures	12
3.0	Complaints	13
4.0	Environmental Monitoring Results	14
4.1	Ambient Air Monitoring Results	15
4.1.1	PM <sub>10</sub> – Monitoring Results	17
4.1.2	PM <sub>10</sub> – Assessment against Annual Criteria	17
4.1.3	PM <sub>10</sub> – Assessment against 24 Hour Criteria	17
4.1.4	Fluoride – 24 Hour Monitoring Results	20
4.1.5	Fluoride – Weekly (7-Day) Monitoring Results	21
4.2	Fluoride Impact on Vegetation	23
4.2.1	Visual Condition Assessment Results – Impact Sites	25
4.2.2	Visual condition Assessment Results – Reference Site	28
4.2.3	Fluoride Content Assessment Results	28
4.3	Meteorological Monitoring	29
4.4	Stack Emissions Testing	30
4.5	Noise Monitoring	32
4.5.1	Site Boundary Monitoring	33
4.5.2	Predicted Noise Levels	34
4.5.3	Assessment Against Short-Term Nighttime Criteria	34
4.6	Water	35
4.6.1	Water Usage	35
4.6.2	Stormwater Quality	35
4.7	Waste Generation	36
5.0	Discussion of Environmental Performance	38
5.1	Ambient Air Quality	38
5.2	Fluoride Impact on Vegetation	42
5.2.1	Trends in Visual Impact on Vegetation	42
5.2.2	Trends in Fluoride Content in Vegetation	43
5.2.3	Reference Site	46
5.2.4	Relationship between Visual Symptoms and Foliar Fluoride Content	47
5.3	Meteorological Monitoring	47
5.4	Air Pollutant Load Limits	48
5.5	Noise	53
5.6	Water	55
5.6.1	Water Usage	55
5.6.2	Process Water Management	55
5.6.3	Stormwater Quality	56
5.6.4	Stormwater Management	57
5.7	Waste	58
5.7.1	Waste Generation	58
5.7.2	Waste Management	58
6.0	Non-Compliances	59
6.1	2019-2020 Non-Compliances Record	59
6.2	Audit Recommendations and Action Plan	59
7.0	Continuous Improvement Measures	65
7.1	General Environmental Management	65
7.2	Energy Efficiencies	67

8.0	References	68
Appendix A	Fluoride Impact on Vegetation Data	A
Appendix B	Meteorological Monitoring - Wind Roses	B

### List of Tables

Table 1-1	Schedule 4, Condition 60 of Project Approval (MP 09_0006)	11
Table 3-1	Historical complaints received by NCIA	13
Table 4-1	Summary of ambient air monitoring: PM <sub>10</sub> results	17
Table 4-2	Summary of ambient air monitoring: 24-hour fluoride results	20
Table 4-3	Summary of ambient air monitoring: weekly fluoride results	21
Table 4-4	Symptom code for visible injury to vegetation with particular reference to fluoride	23
Table 4-5	Proportion of surveyed species showing injury symptoms	25
Table 4-6	Sites and species within the survey area selected for foliage fluoride content assessment	29
Table 4-7	Emission source descriptions	30
Table 4-8	Summary of particulate emission monitoring results (July 2020)	31
Table 4-9	Summary of emission monitoring results – Kiln 1 and Kiln 2 (July 2020)	31
Table 4-10	Received noise levels during attended noise monitoring (1 May 2020)	32
Table 11	May 2020 – Site Boundary Measurement Results	33
Table 12	May 2020 – Calculated Noise Levels at the Receiver Locations	34
Table 5-1	Meteorological station up-time	47
Table 5-2	Comparison of emission concentrations used in 2010 EA modelling and measured in stack emission concentrations for the current reporting period	49
Table 5-3	Maximum pollutant load limits and assessable pollutant loads	50
Table 6-1	Details of non-compliance with EPL or Project Approval conditions during the 2019 reporting period	59
Table 6-2	Audit recommendations and NCIA action plan	60
Table 7-1	Timetable for environmental improvement actions	65

**List of Figures**

Figure 1	Production volume since 2004	10
Figure 2	Ambient air monitoring locations	16
Figure 3	PM <sub>10</sub> monitoring – northwest location	19
Figure 4	PM <sub>10</sub> monitoring – southeast location	19
Figure 5	24-hour fluoride monitoring – northwest location	20
Figure 6	24 hour fluoride monitoring – southeast location	21
Figure 7	Weekly fluoride monitoring – northwest location	22
Figure 8	Weekly fluoride monitoring – southeast location	22
Figure 9	Vegetation survey monitoring location	24
Figure 10	Relative prevalence of fluoride related symptoms	25
Figure 11	Proportion of flora species affected by emissions related visual injury symptoms during the surveys	27
Figure 12	Relationship between distance from kiln stacks and maximum visual injury score in foliage of species assessed	28
Figure 13	Average monthly rainfall and temperature range (1 August 2019 – 31 July 2020)	30
Figure 14	Stormwater quality monitoring – pH	35
Figure 15	Stormwater quality monitoring – EC	36
Figure 16	Tile waste (green and fired) generation during 2019-2020	37
Figure 17	24-hour PM <sub>10</sub> monitoring – northwest location (2004 – 2020)	39
Figure 18	24-hour PM <sub>10</sub> monitoring – southeast location (2004 – 2020)	39
Figure 19	24-hour fluoride monitoring – northwest location (2004 – 2020)	40
Figure 20	24-hour fluoride monitoring – southeast location (2004 – 2020)	40
Figure 21	Weekly fluoride monitoring – northwest location (2004 – 2019)	41
Figure 22	Weekly fluoride monitoring – southeast location (2004 – 2020)	41
Figure 23	Proportion of flora species affected by emission related visual injury symptoms (2007-2020)	42
Figure 24	Fluoride content in <i>E. moluccana</i> foliage at Site 5 (Q1 2007 – Q2 2020)	45
Figure 25	Fluoride content in grasses at Site 11 (Q1 2004 – Q2 2020)	45
Figure 26	Fluoride content in <i>E. amplifolia</i> and <i>C. maculata</i> foliage at Site 13 (Q4 2007 – Q2 2020)	45
Figure 27	Fluoride content in <i>C. maculata</i> foliage at Site 15 (Q1 2004 – Q2 2020)	45
Figure 28	Fluoride content in <i>Vitis vinifera</i> foliage at Site 19 (Q1 2004 – Q2 2020)	46
Figure 29	Fine particulate annual load (2004 – 2020)	51
Figure 30	Coarse particulate annual load (2004 – 2020)	51
Figure 31	Fluoride annual load (2004 – 2020)	52
Figure 32	Sulfur oxides (as sulphuric acid mist and sulfur trioxide (as SO <sub>3</sub> )) annual load (2004 – 2020)	52
Figure 33	Nitrogen oxides annual load (2004 – 2020)	53
Figure 34	Day noise levels 2004 – 2020	54
Figure 35	Evening noise levels 2004 – 2020	54
Figure 36	Night noise levels 2004 – 2020	55
Figure 37	Stormwater quality, pH – Pond 4 (2009-2020)	56
Figure 38	Stormwater quality, EC – Pond 4 (2009-2020)	57
Figure 39	Gas efficiency in tile manufacturing process	67

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## 1.0 Introduction

National Ceramic Industries Australia Pty Ltd (NCIA) operates a tile manufacturing facility located in Rutherford, New South Wales. This Annual Environmental Management Report (AEMR) describes and discusses NCIA's environmental performance for the period between 1 August 2019 and 31 July 2020 (hereafter referred to as the '2020 reporting period').

### 1.1 NCIA Background

#### 1.1.1 Current Operations

NCIA manufactures ceramic wall and floor tiles for the Australian market from its facility located off Racecourse Road, Rutherford, within the Rutherford Industrial Estate, NSW. The facility has been operating since its commissioning in 2004. Prior to NCIA's operations, the majority of Australia's domestic ceramic tile consumption was imported from China, South East Asia, Italy, Spain and Brazil.

Tiles are manufactured from raw materials including a mixture of clay, white granite, rhyolite and glazes. Clay, granite and rhyolite are naturally occurring and are supplied by quarries within Australia, whilst glazes and other consumables are either supplied locally or imported. The tile manufacturing process involves mixing and preparing raw materials in specified proportions, pressing the prepared mix into the desired shape, and then drying prior to decorating and glazing. The tiles are then fired in the facility's kilns prior to sorting, packaging and dispatch. Finished tiles are stored and loaded for distribution outside of the building in the south western corner of the site. All transport to and from the site is via road, with semi-trailers and B-double trucks transporting the raw materials and finished product.

The operation currently comprises one spray drier, a clay mill, two tile production lines and two kilns, all housed within a single factory building approximately 488 m long and 80 m wide. The current operations represent the first two of eight approved stages of the facility. With these two operational stages the maximum production of the facility is approximately 6.4 million m<sup>2</sup> of ceramic tiles per annum. The facility operates 24 hours per day, 7 days per week, and currently employs 52 full time staff.

#### 1.1.2 Future Planned Operations

NCIA currently holds approval for the development of Stages Three–Eight of the facility, none of which are yet constructed or commissioned. Stages Three–Four would see the commissioning of an additional two production lines within the existing factory building for an increased production of up to 12.8 million m<sup>2</sup> of tiles per annum. Stages Five–Eight would involve the construction and operation of a second factory building with four additional production lines on the adjacent parcel of land to the east of the existing facility. Once all eight development stages are operational, the facility's production capacity would increase to 25.6 million m<sup>2</sup> of tiles per annum.

The approval for the facility's expansion was sought by NCIA in response to the anticipated continuing increase in tile demand, both domestically and internationally. The timeline for construction of the remaining stages (i.e. Stages Three–Eight) is dependent upon market demand and remains uncertain at the time this AEMR has been prepared.

#### 1.1.3 Historic and Current Production Volume

Tile production volume since commissioning and inclusive of the 2020 reporting period is presented in **Figure 1**. Production volume is reported (and presented here) annually in accordance with the Environmental Protection Licence (EPL) annual reporting period, that is 1 August to 31 July each year.

NCIA's Project Approval (MP 09\_0006) provides a staged approach to production limit in m<sup>2</sup> per annum, while NCIA's EPL No. 11956 provides for production in tonnes per annum.

Between 1 August 2019 and 31 July 2020, the facility operated 330 days, for a total output of 79,860 tonnes of ceramic tiles (or approximately 5.04 million m<sup>2</sup>). These production levels are below the maximum production authorised under NCIA's current approvals (refer to **Section 1.2**) and are commensurate to the current stage of development of the facility (i.e. Stage Two).

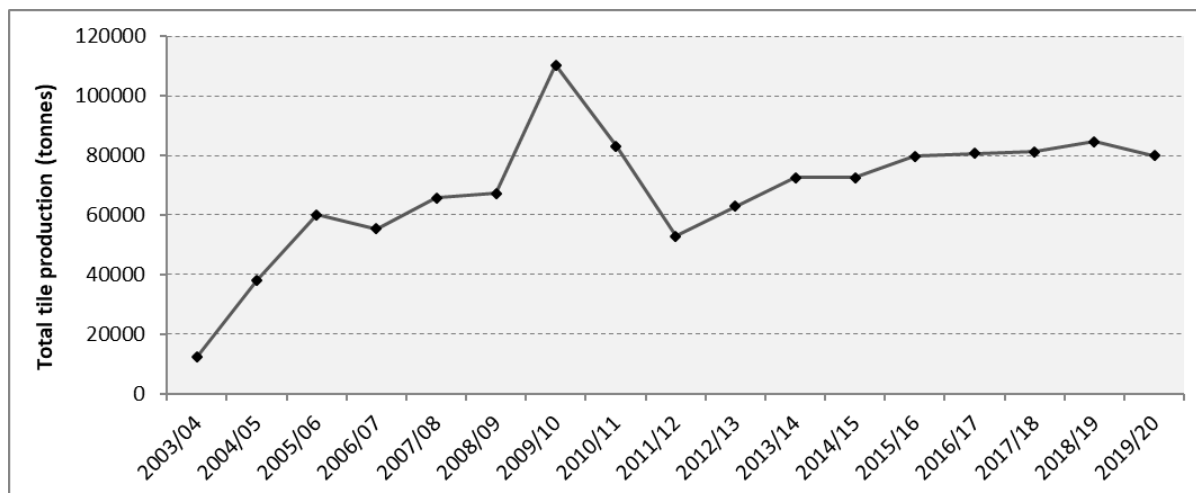


Figure 1 Production volume since 2004

## 1.2 Regulatory Context

### 1.2.1 Current Approvals

On 19 January 2012 NCIA was granted Project Approval (MP 09\_0006), which rationalised and consolidated the development as approved under the previous Development Consent (DA 449-12-2002-i), and the proposed expansion of the facility. Subsequently, NCIA relinquished the previous Development Consent with effect from 19 January 2013.

The NCIA facility is therefore currently operating in accordance with the conditions of Project Approval (MP 09\_0006), issued by the Department of Planning Industry and Environment (DPIE).

The facility also operates in accordance with EPL No. 11956 issued by the NSW Environment Protection Authority (EPA), which authorises NCIA to produce 50,000 - 200,000 tonnes of ceramic tiles per annum.

It is noted that many of the requirements of the Project Approval are required prior to commencement of construction of the next stage of the approved operation (i.e. Stages Three–Eight). As commencement of construction of the next stage of the approved operation has not yet commenced, these conditions have not yet been activated.

Notably, an Operation Environmental Management Plan (OEMP) was prepared in accordance with the previous Development Consent to provide an environmental management framework for the facility. The current Project Approval does not require an OEMP, but instead requires the preparation of an Environmental Management Strategy (EMS) prior to commencement of construction works associated with development Stages Three–Eight. As this condition is not yet activated, NCIA continues to operate in accordance with the OEMP.

### 1.2.2 AEMR Requirement

This AEMR has been prepared in accordance with Schedule 4, Condition 60 of the Project Approval. The AEMR outlines the environmental compliance and performance of the NCIA facility in relation to the conditions of the Project Approval and NCIA's EPL No. 11956.

The requirements of Condition 60 of the Project Approval and the cross-reference to the AEMR section where the requirement is addressed are provided in **Table 1-1**.

**Table 1-1 Schedule 4, Condition 60 of Project Approval (MP 09\_0006)**

Condition	Requirement	AEMR Section
60	Every year from the date of this approval <sup>1</sup> , unless the Director-General agrees otherwise, the Proponent shall submit an AEMR to the Director-General and relevant agencies. The AEMR shall:	This AEMR
60 (a)	be conducted by suitably qualified team whose appointment has been endorsed by the Director-General;	Quality Information
60 (b)	be submitted within 3 months of the period being assessed by the AEMR;	See comment 1 below
60 (c)	identify the standards and performance measures that apply to the development;	Section 2.0
60 (d)	include a summary of the complaints received during the past year, and compare this to the complaints received in previous years;	Section 3.0
60 (e)	include a summary of the monitoring results for the development during the past year;	Section 4.0
60 (f)	include an analysis of these monitoring results against the relevant: <ul style="list-style-type: none"> <li>• impact assessment criteria;</li> <li>• monitoring results from previous years; and</li> <li>• predictions in the EA.</li> </ul>	Section 5.0
60 (g)	identify any trends in the monitoring;	Section 5.0
60 (h)	identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies;	Section 5.0
60 (i)	identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance; and	Section 6.0
60 (j)	identify continuous improvement measures, outlining new developments in air quality and noise control, and detailing practices that have been implemented on the site during the previous year, to reduce air quality and noise impacts.	Section 7.0

**Note on timeline**

NCIA sought DPIE's approval (during a meeting with Leah Cook of DPIE held on 15 July 2015) to amend the AEMR reporting timeframes to align it with that of the EPL. The request was granted by DPIE on 17 July 2015. Therefore, this AEMR and all subsequent AEMRs will cover the same reporting periods as the EPL, and report on NCIA's environmental performance between 1 August and 31 July each year.

<sup>1</sup> This condition is now superseded by DPIE's approval to amend the AEMR reporting period so that it is aligned with that of the EPL reporting timeline. The AEMR now covers the period between 1 August and 31 July.

## 2.0 Standards and Performance Measures

The NCIA OEMP provides the environmental management framework to guide the operation and environmental performance of the facility. The OEMP defines the environmental management practices, procedures and personnel responsibilities to ensure compliance with conditions of statutory approvals and licences.

Specific environmental standards and performance measures used to assess the achievement of environmental objectives are drawn from requirements, obligations and initiatives listed within:

- Project Approval (MP 09\_0006), granted by the Minister for Planning;
- EPL 11956, issued by the NSW EPA; and
- The *National Ceramic Industries Australia Expansion - Environmental Assessment* (AECOM, 5 July 2010) hereafter referred to as '2010 EA'.

Commitments made within the 2010 EA have been incorporated into the Project Approval and EPL for the facility as compliance criteria. These compliance criteria are used to assess the environmental performance of the facility and to monitor the environmental impact on the surrounding environment. Compliance criteria and the monitoring results for the current reporting period are presented in **Section 4.0** of this AEMR.



### 3.0 Complaints

Condition 60(d) of the Project Approval requires that the AEMR include a summary of complaints received during the current reporting period compared to complaints received in previous years.

The history of complaints received by NCIA is presented in **Table 3-1**. Only one complaint was received for the monitoring period with NCIA being confirmed as not responsible. Overall, the history of complaints shows that very few community complaints are received in relation to NCIA operations.

**Table 3-1 Historical complaints received by NCIA**

Year	Number of Complaints	Issue	Details
2020	Nil	Nil	None Required.
2019	1	Noise	Complaint made from resident of Heritage Parc wondering whether alarm noise ongoing since 9am. was NCIA as it could be heard from Heritage Parc. NCIA supervisor confirmed the alarm was not from NCIA. Supervisor drove down Gardiner St and noted an alarm from a business at the South West corner of NCIA.
2018	Nil	Nil	None Required.
2017	Nil	Nil	None Required.
2016	Nil	Nil	None Required.
2015 (partial)	Nil	Nil	None Required.
2014	Nil	Nil	None Required.
2013	1	Air Quality	Complaint made via email on 24 July 2013 regarding air quality in Rutherford area.
2012-13	1	1	Complaint made from neighbouring Heritage Green Residential Estate regarding storage of waste tiles causing visual nuisance. It is noted that this was previously considered to be a legal issue and therefore not previously recorded as a complaint.
2011-12	Nil	Nil	None Required.
2010-11	Nil	Nil	None Required.
2009-10	1	Air Quality	Complaint made from neighbouring Heritage Green Residential Estate regarding non-compliances identified in the Environment Audit.
2008-09	Nil	Nil	None Required.
2007-08	1	Air Quality	Anonymous complaint to EPA regarding visible black smoke. Report submitted to EPA on 25 March 2008. Visible black smoke unlikely to have originated from NCIA. No further action required.
2006-07	1	Odour	Anonymous complaint to EPA regarding odour. Discussed with EPA. Odour unlikely to have originated from NCIA. No further action required.
2005-06	2	Air Quality / Odour	Complaint made regarding visible plume. Complainant contacted and issue discussed. No further action required.  Anonymous complaint to EPA regarding odour. Discussed with EPA. Odour unlikely to have originated from NCIA. No further action required.
2004-05	1	Air Quality	Complaint made regarding visible plume. Complainant contacted and issue discussed. No further action required.

## 4.0 Environmental Monitoring Results

The following environmental parameters are monitored in accordance with the conditions of the Project Approval and / or the EPL and / or for internal due diligence requirements:

- Ambient air monitoring (northwest and southeast of the facility):
  - Fine Particulates (PM<sub>10</sub>); and
  - Fluoride (particulate, gaseous and total).
- Fluoride Impact on Vegetation:
  - Quarterly visual assessment of vegetation; and
  - Quarterly fluoride content in vegetation.
- Meteorological monitoring:
  - Wind speed at 10 metres;
  - Wind direction at 10 metres;
  - Temperature at 5 metres; and
  - Rainfall.
- Stack emission testing (all stacks):
  - Total particulates; and
  - Fine particulates (PM<sub>10</sub>).
- Additionally, for the kiln stacks:
  - Mercury (Hg);
  - Cadmium (Cd);
  - Nitrogen Oxides (NO<sub>x</sub>);
  - Hazardous substances (metals);
  - Hydrogen Fluoride (HF);
  - Sulfuric acid mist (H<sub>2</sub>SO<sub>4</sub>); and
  - Sulfur trioxide (SO<sub>3</sub>).
- Noise monitoring:
  - L<sub>Aeq</sub>(15 minute); and
  - L<sub>A1</sub>(1 minute).

In addition to the above-listed parameters, NCIA also keeps internal records of water usage and waste production. Water quality monitoring is also undertaken of the stormwater contained in the water retention basins.

A summary of the monitoring results for these parameters during the current reporting period is provided below.

## 4.1 Ambient Air Monitoring Results

The ambient air quality monitoring program commenced on 12 March 2004 to record background data prior to commencement of Stage One operations. The program was designed and implemented in accordance with the requirements of NCIA's EPL. The monitoring program also satisfies the requirements of the Project Approval.

In accordance with EPL condition M2.1, PM<sub>10</sub> (24-hour) and Fluoride (24-hour and weekly) are monitored at two locations: northwest and southeast of the facility (refer **Figure 2**).

For PM<sub>10</sub> monitoring, two sampling locations have been established to determine concentrations at the NCIA property boundary, along the dominant southeast-northwest wind axis. The monitors are sited in accordance with *AS/NZS 3580.1.1:2016 Guide to siting air monitoring equipment*. Sampling and analyses of PM<sub>10</sub> are undertaken as per *AS/NZS 3580.9.6:2015 Determination of suspended particulate matter*. Discrete 24-hour samples are collected every 6 days according to the NSW EPA schedule.

Two fluoride monitoring units (manual, double filter paper samplers) have been sited at each of the two locations identified for monitoring of PM<sub>10</sub> and are operated in accordance with *AS3580.13.2:2013 Determination of gaseous and acid-soluble particulate fluorides*. At each location, one monitor operates continuously over a 7-day period to provide weekly fluoride concentration averages. These units are designated 'Northwest HF<sub>7</sub>' and 'Southeast HF<sub>7</sub>'. The remaining unit at each site operates continuously for discrete 24-hour periods according to the NSW EPA 6-day cycle to provide 24-hour averages for sampler operation days. Units are designated 'Northwest HF' and 'Southeast HF'.



Figure 2 Ambient air monitoring locations



#### 4.1.1 PM<sub>10</sub> – Monitoring Results

The EPL does not specify ambient air concentration limits, however Condition 15 of the Project Approval sets out criteria for PM<sub>10</sub>.

A summary of PM<sub>10</sub> monitoring results from both monitoring locations for the current reporting period is provided in **Table 4-1**, alongside the relevant criteria. The PM<sub>10</sub> results for the NW and SE locations are also graphed in **Figure 3** and **Figure 4** respectively.

**Table 4-1 Summary of ambient air monitoring: PM<sub>10</sub> results**

Parameter	Criteria	NW Location	SE Location
Annual Average Concentration (µg/m <sup>3</sup> )	30.0	<b>33.6</b>	23
Standard Deviation (µg/m <sup>3</sup> )	-	22.82	18.4
24-hour Minimum Concentration (µg/m <sup>3</sup> )	-	8.4	5.6
24-hour Maximum Concentration (µg/m <sup>3</sup> )	50.0	<b>114</b>	<b>106</b>

Note: **Bold** font indicates an exceedance of the criteria

#### 4.1.2 PM<sub>10</sub> – Assessment against Annual Criteria

The South East location returned an average annual concentration of 23 µg/m<sup>3</sup> which is below the 30 µg/m<sup>3</sup> annual criteria. This annual average remained below this criterion for the duration of the 12 month monitoring period.

At the completion of this 12 month period the North West location returned an annual average of 33.6 µg/m<sup>3</sup> which is above the criteria. The annual average has increased from the previous year value of 30.3 µg/m<sup>3</sup> largely due to elevated results recorded during November and December 2019 caused by regional heavy bushfire smoke. Recent results towards the end of the monitoring period indicate a likely return to values below the criteria.

#### 4.1.3 PM<sub>10</sub> – Assessment against 24 Hour Criteria

This section details any exceedances of the PM<sub>10</sub> 24-hour maximum concentration. Each of these elevated PM<sub>10</sub> monitoring results were promptly notified to DPIE upon receipt of the validated laboratory results, in accordance with the reporting requirements specified in the Project Approval.

Apart from these isolated exceedances, the remainder of PM<sub>10</sub> monitoring results for the NW and SE monitoring locations during the reporting period were below the 24-hour guideline criteria.

There were eleven exceedances of the PM<sub>10</sub> 24-hour maximum concentration at the NW monitoring location:

- 6 August 2019 - PM<sub>10</sub> concentration of 61.8 µg/m<sup>3</sup>
- 24 August 2019 - PM<sub>10</sub> concentration of 64.7 µg/m<sup>3</sup>
- 17 October 2019 - PM<sub>10</sub> concentration of 95.7 µg/m<sup>3</sup>
- 29 October 2019 - PM<sub>10</sub> concentration of 71.8 µg/m<sup>3</sup>
- 22 November 2019 - PM<sub>10</sub> concentration of 86.4 µg/m<sup>3</sup>
- 28 November 2019 - PM<sub>10</sub> concentration of 56.4 µg/m<sup>3</sup>
- 4 December 2019 - PM<sub>10</sub> concentration of 101 µg/m<sup>3</sup>
- 10 December 2019 - PM<sub>10</sub> concentration of 114 µg/m<sup>3</sup>
- 16 December 2019 - PM<sub>10</sub> concentration of 56 µg/m<sup>3</sup>
- 2 February 2020 - PM<sub>10</sub> concentration of 53.6 µg/m<sup>3</sup>
- 26 April 2020 - PM<sub>10</sub> concentration of 56.9 µg/m<sup>3</sup>.

There were five exceedances of the PM<sub>10</sub> 24-hour maximum concentration at the SE monitoring location:

- 29 October 2019 - PM<sub>10</sub> concentration of 50.2 µg/m<sup>3</sup>
- 22 November 2019 - PM<sub>10</sub> concentration of 69.2 µg/m<sup>3</sup>
- 28 November 2019 - PM<sub>10</sub> concentration of 50.9 µg/m<sup>3</sup>
- 4 December 2019 - PM<sub>10</sub> concentration of 77.7 µg/m<sup>3</sup>
- 10 December 2019 - PM<sub>10</sub> concentration of 106 µg/m<sup>3</sup>

Ambient and meteorological conditions on these days were reviewed and discussed below.

### **6 and 24 August 2019**

On 6 August the EPA Beresfield monitoring station recorded a 24hr PM<sub>10</sub> average of 31.6 µg/m<sup>3</sup> while the EPA Singleton monitoring station recorded a result of 42.0 µg/m<sup>3</sup> with these results being the 6th and 4th highest 24 hour averages for the month respectively.

On 24 August the Beresfield monitoring station recorded a 24hr PM<sub>10</sub> average of 37.6 µg/m<sup>3</sup> while the EPA Singleton monitoring station recorded a result of 43.2 µg/m<sup>3</sup> with these results being the 2nd and 3rd highest 24 hour averages for the month respectively.

Meteorological data sourced from the on-site meteorological station shows strong winds from the north west quadrant for both days. Under these conditions the North West monitoring station is upwind of the NCIA site. Wind roses attached show the meteorological data graphically and present the wind direction as 'blowing from'. Also attached is an image showing the site and the monitoring locations.

In summary, the PM<sub>10</sub> results recorded at the North West monitoring location on 6 and 24 August 2019 are likely to be significantly influenced by an upwind dust source and strong north westerly winds. Both the EPA Beresfield and Singleton stations recorded above average 24hr PM<sub>10</sub> concentrations on these days indicating the potential for elevated PM<sub>10</sub> levels. Importantly, the North West monitoring station was upwind of the NCIA site on this day meaning the NCIA facility is unlikely to have contributed to this result.

### **17 and 29 October 2019**

On 17 October the EPA Beresfield monitoring station recorded a 24hr PM<sub>10</sub> average of 27.6 µg/m<sup>3</sup> while the EPA Singleton South monitoring station recorded a result of 46.2 µg/m<sup>3</sup>. Winds were blowing from the North West quadrant, upwind of the NCIA site, suggesting NCIA is unlikely to be the source of any elevated results at the North West monitor on 17 October 2019.

On 29 October the EPA Beresfield monitoring station recorded a 24hr PM<sub>10</sub> average of 54.1 µg/m<sup>3</sup> while the EPA Singleton South monitoring station recorded a result of 50.4 µg/m<sup>3</sup> with regional air quality heavily influenced by bushfire smoke. The North West monitoring location is downwind of the NCIA site when winds are from the South Southeast. The principal wind direction (25 percent) on 29 October was from the East Southeast with only 12 percent of light winds from the South Southeast. It is most likely that both monitors were heavily influenced by the regional bushfire smoke and/or a source or sources other than the NCIA site.

### **22 and 28 November 2019**

On both 22 and 28 November bushfire smoke was prevalent across the region as indicated by elevated results at the EPA Beresfield and Singleton South sites as well as the NCIA facility.

Both onsite monitoring locations have recorded similarly elevated results comparable to, and in some cases below, the regional EPA station results suggesting a regional dust source, in this case bushfire smoke, is the primary source.

### **4, 6 and 10 December 2019**

On 4, 10 and 16 December 2019 bushfire smoke was prevalent across the region as indicated by elevated results at the EPA Beresfield and Singleton South sites as well as the NCIA facility.

Onsite monitoring locations recorded similarly elevated results comparable to the regional EPA station results suggesting a regional dust source, in this case bushfire smoke, as the primary source.

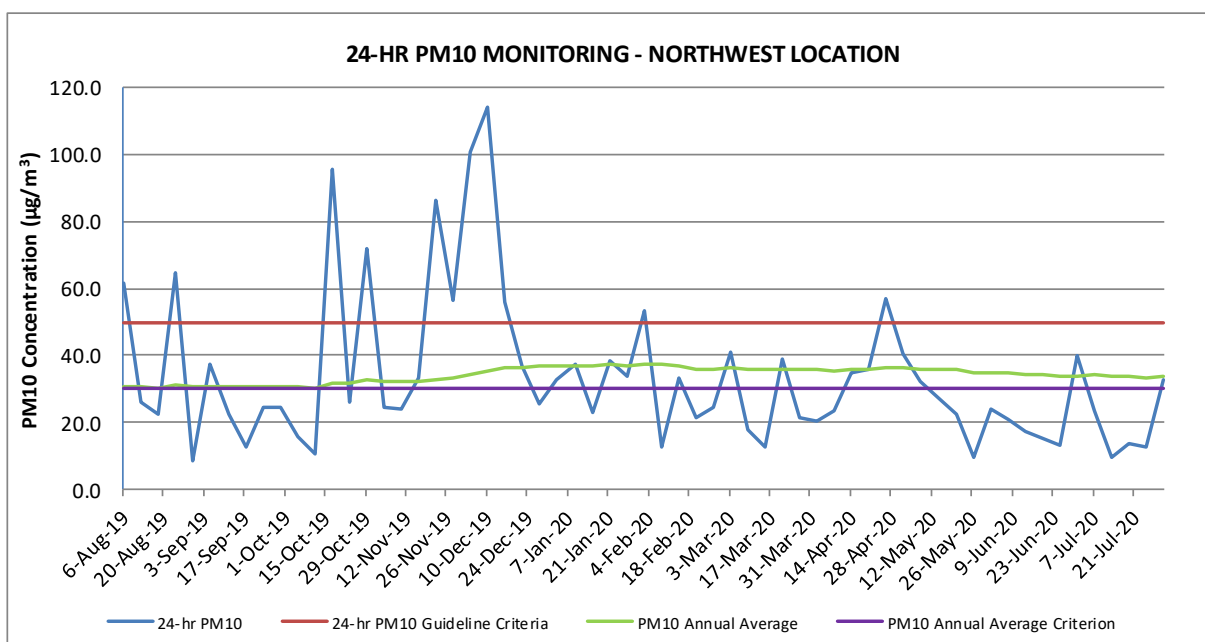
**2 February 2020**

The PM<sub>10</sub> exceedance at the North West sampler on 2 February 2020 was measured during a period of increased regional PM<sub>10</sub> levels and under meteorology conditions that do not place the site upwind of the sampler. This information indicates NCIA is not the source of this exceedance.

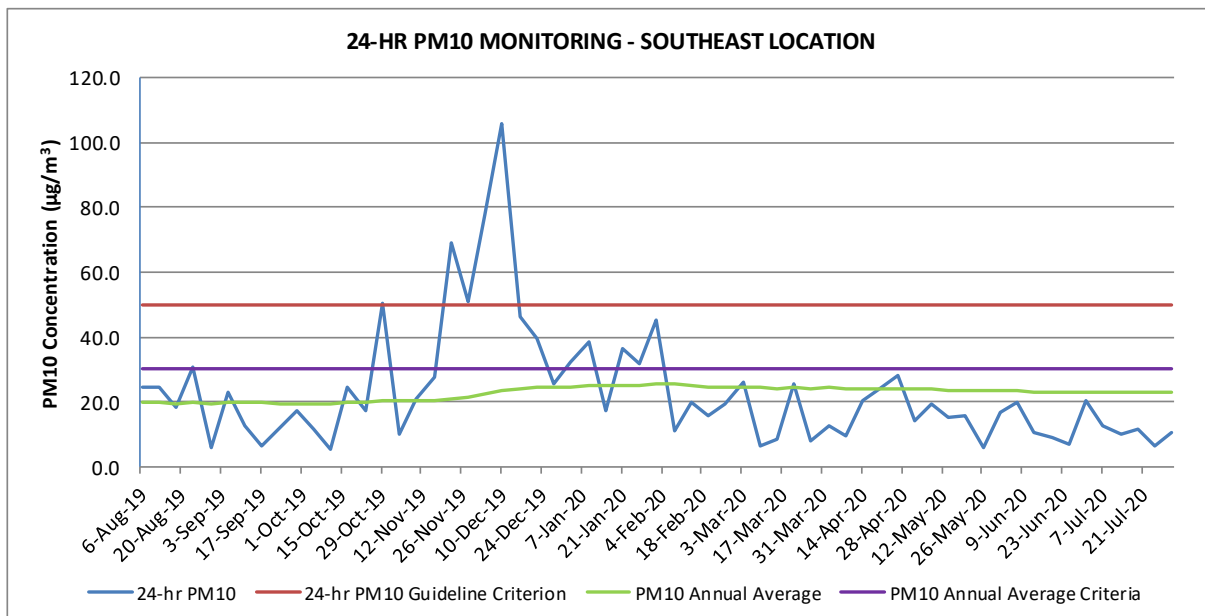
**26 April 2020**

The PM<sub>10</sub> exceedance at the North West sampler on 26 April 2020 was measured during a period of increased regional PM<sub>10</sub> levels and under meteorology conditions that do not place the site upwind of the sampler. This information indicates NCIA is not the source of this exceedance.

Comparison to historical monitoring results and analysis of trends is discussed further in **Section 5.1**.



**Figure 3 PM<sub>10</sub> monitoring – northwest location**



**Figure 4 PM<sub>10</sub> monitoring – southeast location**

#### 4.1.4 Fluoride – 24 Hour Monitoring Results

There is no ambient air fluoride concentration limit specified in the EPL or Project Approval. To provide context for the ambient air monitoring results, guideline levels have been taken from the NSW EPA’s *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

A summary of 24-hour fluoride monitoring results from both monitoring locations for the current reporting period is provided in **Table 4-2**. The 24-hour fluoride monitoring results for the NW and SE locations are also graphed in **Figure 5** and **Figure 6** respectively.

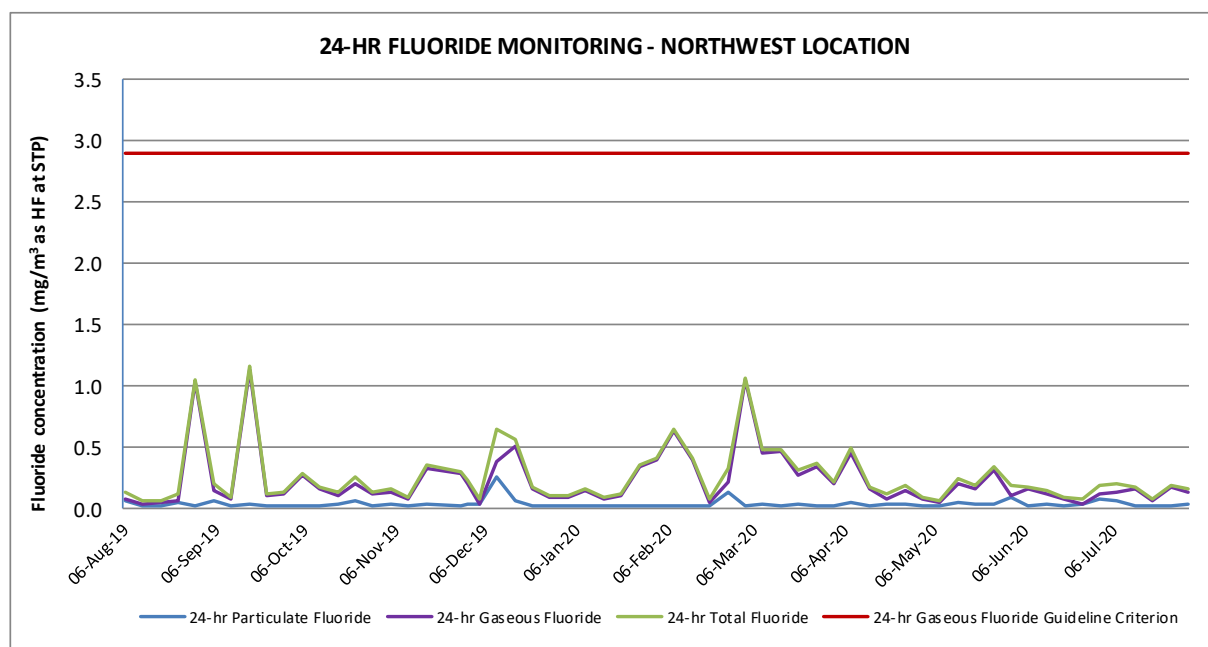
**Table 4-2 Summary of ambient air monitoring: 24-hour fluoride results**

Parameter	Guideline Criteria	NW Location	SE Location
Annual Average Concentration ( $\mu\text{g}/\text{m}^3$ )	-	0.26	0.51
Standard Deviation ( $\mu\text{g}/\text{m}^3$ )	-	0.24	0.49
24-hour Minimum Concentration ( $\mu\text{g}/\text{m}^3$ )	-	0.058	0.060
24-hour Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )	2.9	1.52	2.58

Note: **Bold** font indicates an exceedance of the guideline criteria

The results in **Table 4-2** indicate that both the NW and SE monitoring locations results for the 24-hour total fluoride emissions satisfied the EPA (2016) guideline criterion for the entire reporting period.

Comparison to historical monitoring results and analysis of trends is discussed further in **Section 5.1**.



**Figure 5 24-hour fluoride monitoring – northwest location**



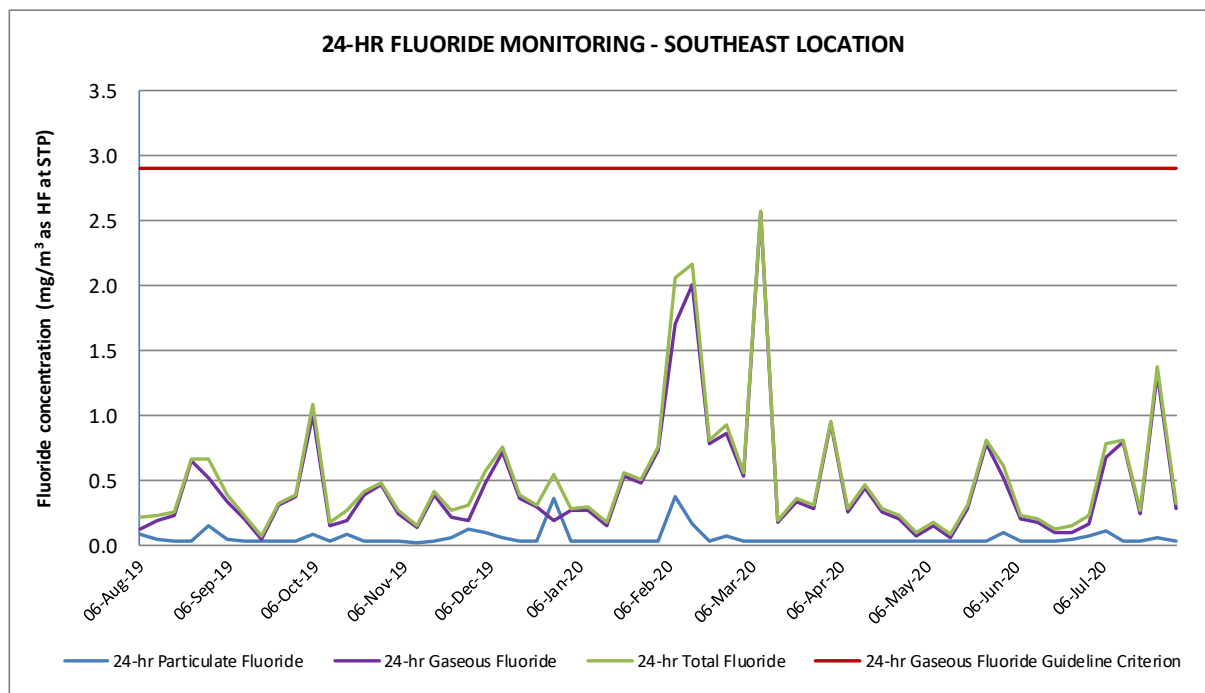


Figure 6 24 hour fluoride monitoring – southeast location

#### 4.1.5 Fluoride – Weekly (7-Day) Monitoring Results

There is no ambient air fluoride concentration limit specified in the EPL or Project Approval. To provide context for the ambient air monitoring results, guideline levels have been taken from the NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

A summary of weekly fluoride monitoring results from both monitoring locations for the current reporting period is provided in **Table 4-3**. The weekly Fluoride monitoring results for the NW and SE locations are also graphed in **Figure 7** and **Figure 8** respectively.

Table 4-3 Summary of ambient air monitoring: weekly fluoride results

Parameter	Guideline Criteria	NW Location	SE Location
Annual Average Concentration ( $\mu\text{g}/\text{m}^3$ )	-	0.130	0.195
Standard Deviation ( $\mu\text{g}/\text{m}^3$ )	-	0.09	0.12
Weekly Minimum Concentration ( $\mu\text{g}/\text{m}^3$ )	-	0.012	0.013
Weekly Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )	1.7	0.45	0.46

The results in **Table 4-3** indicate that for both the NW and SE monitoring locations the weekly Fluoride levels satisfied the EPA (2016) guideline criterion for the entire reporting period.

Comparison to historical monitoring results and analysis of trends is discussed further in **Section 5.1**.

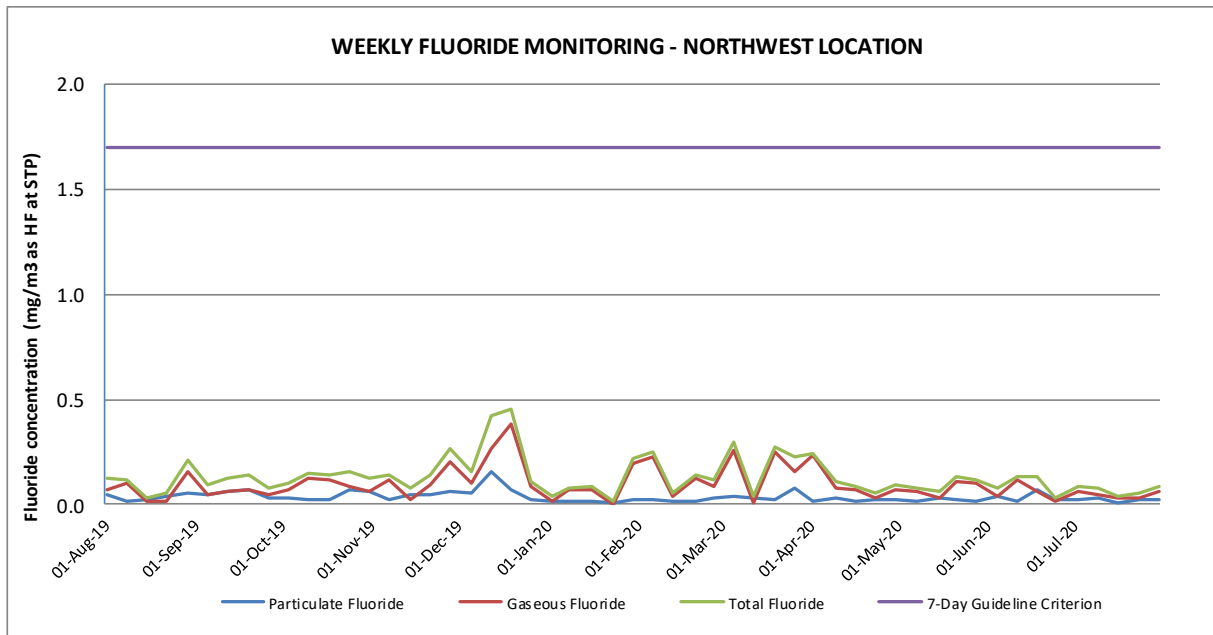


Figure 7 Weekly fluoride monitoring – northwest location

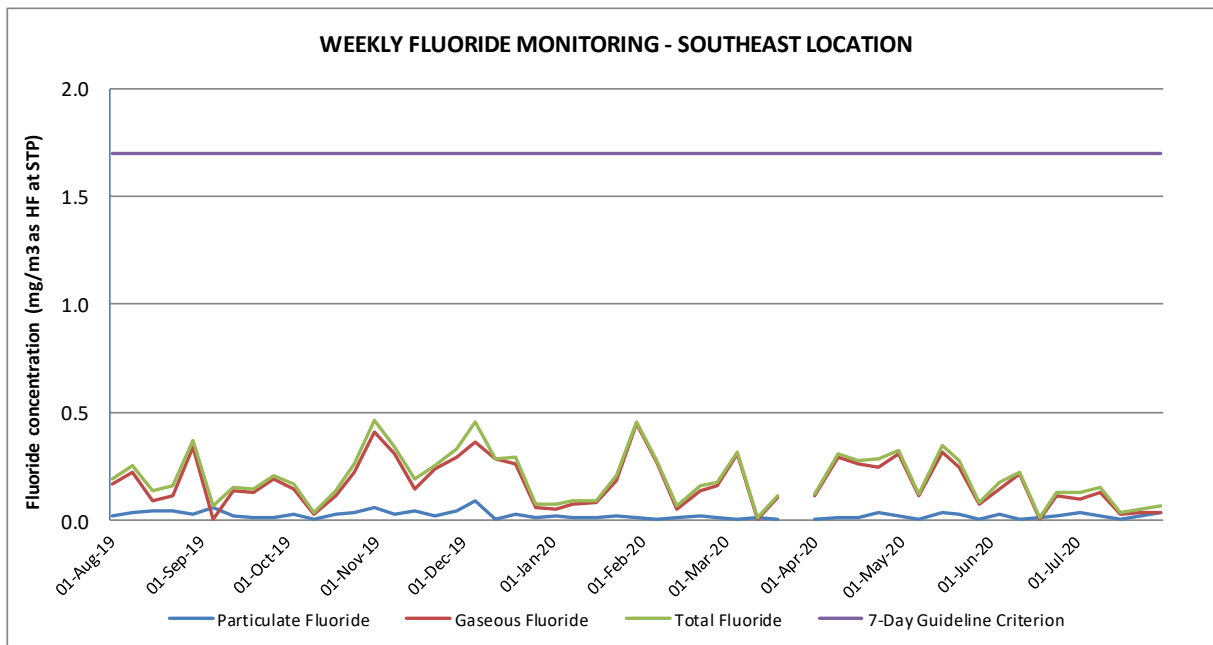


Figure 8 Weekly fluoride monitoring – southeast location

## 4.2 Fluoride Impact on Vegetation

Monitoring the impact of atmospheric fluoride on vegetation in the area surrounding the NCIA facility commenced in 2004. The monitoring program was designed by AECOM based on the assessment methods developed by Dr David Doley of the University of Queensland.

In accordance with condition M4.1 of the EPL, the impact of fluoride on vegetation was monitored by undertaking visual assessments of the condition of local vegetation surrounding the NCIA facility and by foliar sampling of selected flora species for laboratory analysis of fluoride content. Samples chosen for fluoride content analysis were selected on the basis of known species sensitivity toward fluoride, representation of certain species and vegetation type (over storey, cultivated vegetation and forage crops). Generally, the species assessed in the monitoring program were selected based on their known sensitivity to atmospheric fluoride impacts.

Quarterly vegetation assessments were conducted during the reporting period (Q3 September 2019, Q1 March 2020, and Q2 June 2020) as well as an Annual Vegetation Condition Assessment (Q4 December 2019). The results of these surveys are summarised below.

The sites monitored for vegetation condition assessments during the reporting period are shown in **Figure 9**. Details on the monitoring sites as well as a photograph of each monitoring site location (at the time of the annual Q4 2019 survey) are provided in **Appendix A1**. The monitoring locations included eighteen 'impact' sites (comprising eight sites monitored quarterly plus an additional ten sites monitored during the annual survey only) and one 'reference' site. All impact sites were selected to be generally within the areas of highest predicted ambient fluoride concentration – i.e. within the prevailing wind directions for the region (northwest-southeast axis), whilst the reference site location was selected to be outside the prevailing winds.

At each monitoring site and for each of the monitored flora species, the visible injury symptoms to leaves were classified in accordance with the scoring criteria and injury categories presented in **Table 4-4**.

**Table 4-4 Symptom code for visible injury to vegetation with particular reference to fluoride**

Injury Symptom	Emission injury			Insect attack injury
	Chlorosis / Marginal necrosis	Tip necrosis	Cupping	Leaf chewing / sap sucking
Category	% of leaf width / area	% of leaf length	Entire leaf or tree	% of leaf area
0	nil	Nil	nil	nil
1	very slight <2%	very slight <2%	very slight	very slight <2%
2	slight <5%	slight <5%	slight	slight <5%
3	distinct <10%	distinct <10%	distinct	distinct <10%
4	marked <25%	marked <25%	marked	marked <25%
5	severe <50%	severe <50%	severe	severe <50%
6	very severe <75%	very severe <75%	very severe	very severe <75%
7	extreme >75%	extreme >75%	extreme	extreme >75%



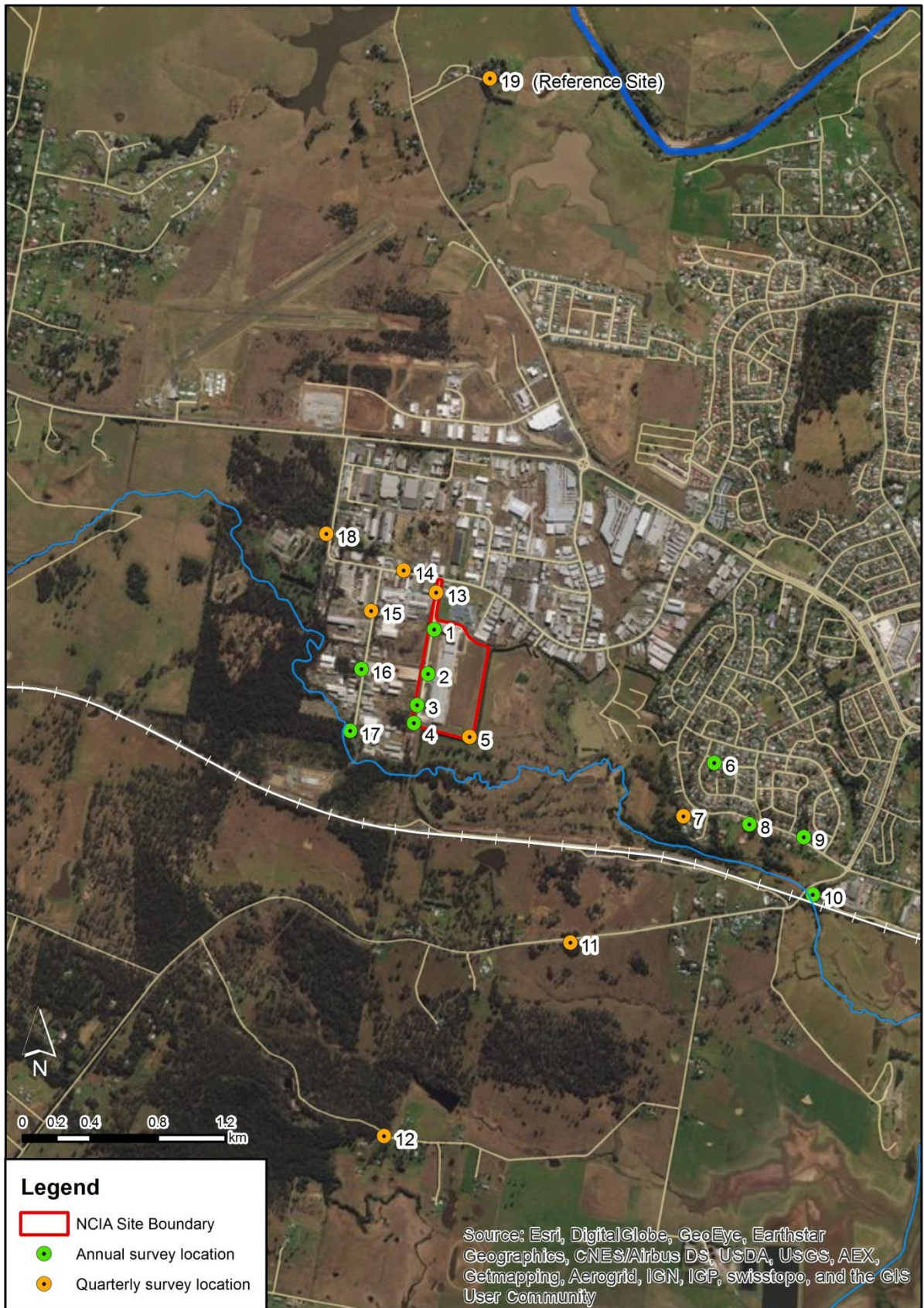


Figure 9 Vegetation survey monitoring location

### 4.2.1 Visual Condition Assessment Results – Impact Sites

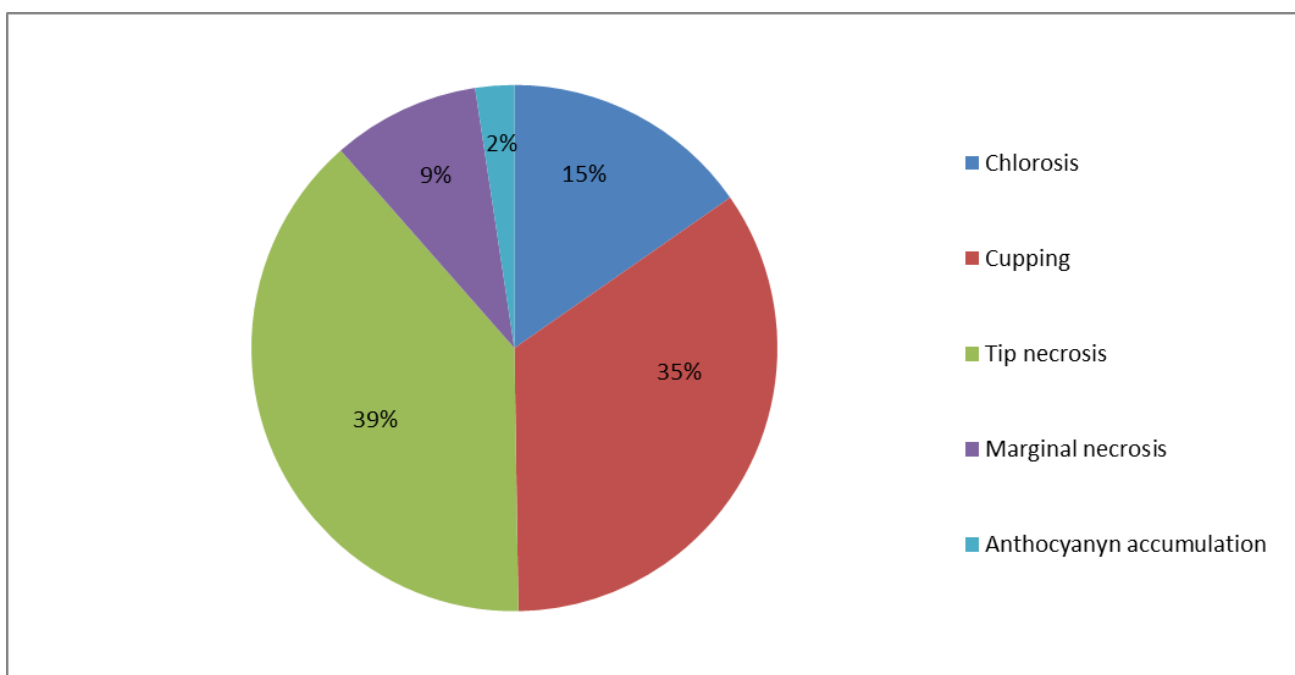
The complete tabulated results of the visible injury assessments performed during the quarterly and annual surveys are provided in **Appendix A2** and a selection of photographs of impacted foliage included in **Appendix A3**. The results have been summarised below and supported graphically in **Figure 10** to **Figure 12**.

The visual assessments found that inclusive of all quarterly surveys during the reporting period, emission related injury symptoms (i.e. chlorosis, cupping, necrosis, anthocyanin accumulation) were present in the foliage of approximately 100% of all species assessed, whilst approximately 78% of all species assessed displayed some level of insect attack injury symptoms (refer to **Table 4-5**). The lower prevalence of emissions and insect attack injury symptoms recorded during the Q4 annual survey is largely due to the inclusion in this survey of several species that are known to be less sensitive to injury symptoms (e.g. *acacia*, *casuarina*, *pinus*, and *hakea* spp.), whereas quarterly surveys only include sensitive eucalypt species.

**Table 4-5 Proportion of surveyed species showing injury symptoms**

	Emission related injury symptoms					Insect injury symptoms				
	Q3 2019	Q4 2019	Q1 2020	Q2 2020	TOTAL	Q3 2019	Q4 2019	Q1 2020	Q2 2020	TOTAL
<b>No. species assessed</b>	17 (100%)	65 (100%)	17 (100%)	17 (100%)	<b>118</b> <b>(100%)</b>	17 (100%)	65 (100%)	17 (100%)	17 (100%)	<b>118</b> <b>(100%)</b>
<b>Injury symptoms present</b>	17 (100%)	42 (65%)	16 (94%)	17 (100%)	<b>92</b> <b>(79%)</b>	17 (100%)	40 (62%)	17 (100%)	17 (100%)	<b>91</b> <b>(78%)</b>
<b>Injury symptoms absent</b>	0 (0%)	23 (35%)	1 (6%)	0 (0%)	<b>24</b> <b>(21%)</b>	0 (0%)	25 (38%)	0 (0%)	0 (0%)	<b>25</b> <b>(22%)</b>

**Figure 10** shows the prevalence of each visual foliage injury symptom observed in all species during the surveys. It indicates that tip necrosis, leaf undulation / cupping, and chlorosis were the most commonly occurring symptoms (with 89% of all observations), followed by marginal necrosis (9%), whilst symptoms of anthocyanin accumulation were generally uncommon (2% of all observations).

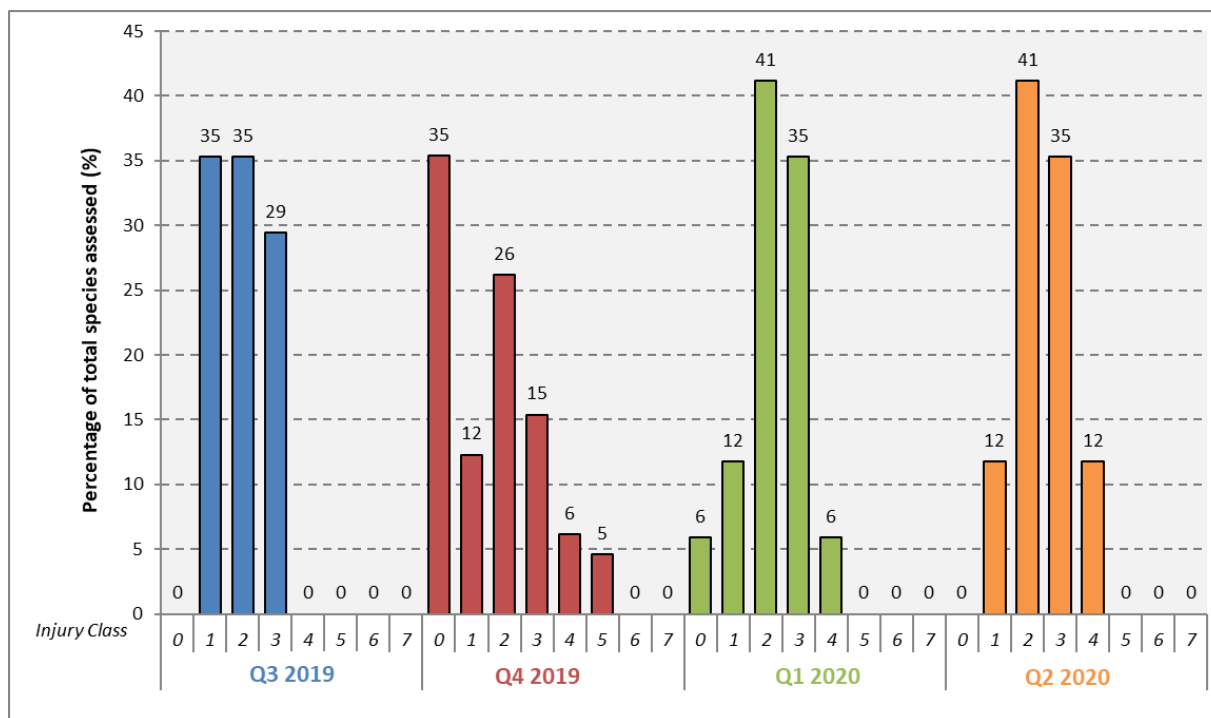


**Figure 10 Relative prevalence of fluoride related symptoms**

The severity of recorded emission related injury symptoms overall ranged from very slight to very severe (i.e. between 2% and 75% of leaf area affected – refer to **Table 4-4**). For each quarterly survey

during the reporting period, **Figure 11** depicts the distribution of injury severity classes recorded in all flora species surveyed. The results indicate the following:

- For each survey between 53% and 73% of plants surveyed were affected at worst by slight injury symptoms (i.e. injury class 2 and less, maximum of 5% leaf area impacted);
- For each survey between 21% and 47% of plants surveyed were affected by distinct or marked injury symptoms (i.e. injury class 3 or 4, 10-25% of leaf area impacted);
- During the annual Q4 2019 survey only, 5% of plants surveyed displayed severe to very severe visual injury symptoms (i.e. injury class 5 or 6, 50-75% of leaf area impacted); and
- No species displayed extreme injury symptoms (i.e. injury class 7, >75% of leaf area impacted) during the four surveys.

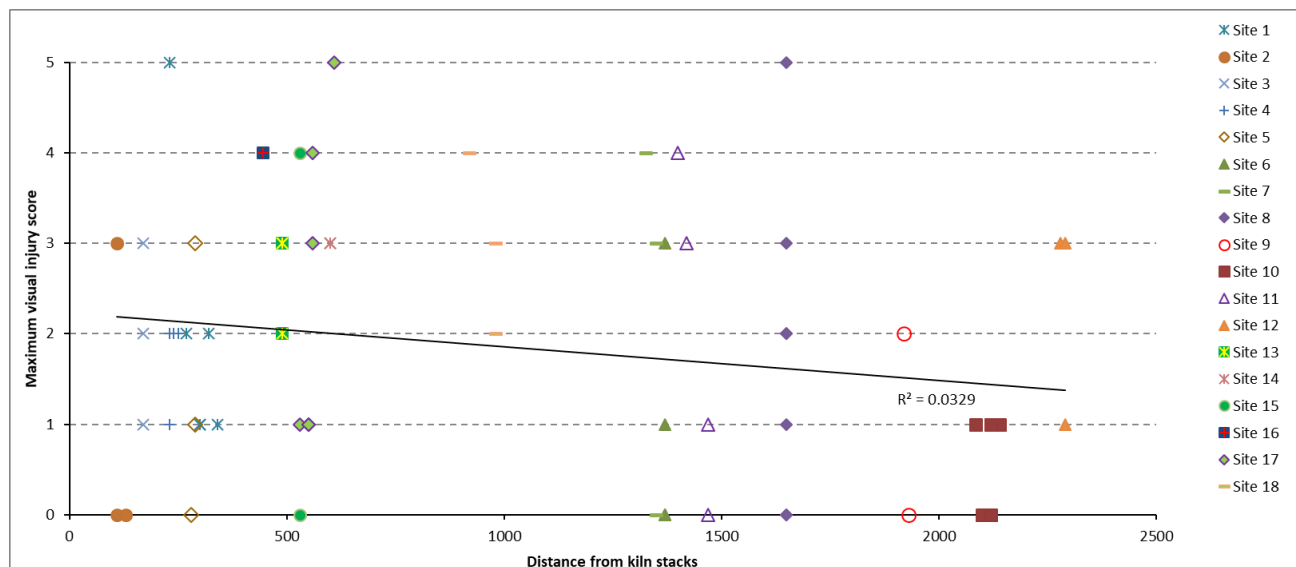


**Figure 11 Proportion of flora species affected by emissions related visual injury symptoms during the surveys**

In relation to insect attack injury, approximately 34% of all symptoms recorded were very slight (i.e. less than 2% leaf area affected), approximately 29% were slight (i.e. 2–5% leaf area affected), approximately 14% were distinct (i.e. 5–10% leaf area affected) and approximately 2% were marked (10-25% leaf area affected). No severe (or higher) insect injury symptoms were recorded.

**Figure 12** depicts the relationship between the maximum emission related visual injury score recorded for each species (inclusive of all surveys) and their distance from the kiln stacks at NCIA. The results showed little correlation between foliage injury and the distance to the emission source ( $r^2 = 0.03$ ), indicating that emission impacts to foliage may spread further from the NCIA site than the furthest monitoring site. For instance, category 4 injury symptoms were observed up to ~1,400m away from the NCIA facility at Site 7, while category 3 symptoms occurred as far as Site 12 (~2,300m from the NCIA facility). This also suggests that within the current suite of monitoring sites, variables such as flora species type or the sensitivity of specific individuals are more relevant than the distance from emission source in determining atmospheric fluoride impacts on local vegetation. However, and importantly, there are several other air pollution sources in the region which may impact vegetation and foliage condition. Therefore, the geographical extent of fluoride impacts to foliage attributable to NCIA activities alone cannot be confidently determined.





**Figure 12 Relationship between distance from kiln stacks and maximum visual injury score in foliage of species assessed**

#### 4.2.2 Visual condition Assessment Results – Reference Site

A broad diversity of species was assessed at this site, which is located approximately 3km north of the kiln stacks at NCIA. Generally, the surveyed vegetation was in a good and healthy condition with species not showing signs of chlorosis, marginal necrosis or anthocyanin accumulation. Some foliage injury symptoms were recorded including leaf cupping and tip necrosis, however those were only detected in a minority of the species surveyed and their severity was typically limited to class 1 (very slight) or class 2 (slight) injuries (with three exceptions in the *Corymbia maculata* and *Eucalyptus tereticornis* individuals. *Corymbia maculata* showed distinct (class 3) cupping symptoms during Q3 2019, Q4 2019 and Q1 2020 and *Eucalyptus tereticornis* individuals showed Class 4 Tip Necrosis in Q4 2019.

Insect attack injury symptoms were recorded in 38% of all species assessed at the reference site (mostly in eucalypt species) with their severity ranging from very slight to slight (class 2 injury).

#### 4.2.3 Fluoride Content Assessment Results

Foliage samples for fluoride content assessment were collected from various established locations during each of the surveys undertaken during the reporting period. Where possible both current and previous season leaves were collected for analysis and mixed to create a bulk sample for the site. Grasses at Wollombi Road (Site 11) were sampled in approximate proportion to their representation or percentage ground cover at the sampling site and were collected at a height judged to be that at which cattle would graze (thereby avoiding the inclusion of soil and roots).

Samples were sent to a NATA accredited laboratory for analysis and the results are provided in **Table 4-6**. Detailed results as provided by the laboratory (certificates of analysis) have been included in **Appendix A4**.

Foliar fluoride content results generally show that:

- Individual species and plants show varying degrees of resistance and/or sensitivity to impacts caused by atmospheric fluoride impacts with recorded foliar fluoride concentrations ranging from <10.0mg/kg to 97.3mg/kg; and
- For each individual species sampled, foliar fluoride concentrations show seasonal variations, reflecting the dominant wind patterns in the area – i.e. with concentrations increasing (or decreasing) as the dominant winds blow toward (or away from) the monitoring sites from the NCIA kiln stacks.

A comparison of these results to previous years and further discussion are provided in **Section 5.2** of this AEMR.



**Table 4-6 Sites and species within the survey area selected for foliage fluoride content assessment**

Site #	Species	Foliage Season Sampled	Fluoride Content ( $\mu\text{g/g}$ , dry)			
			Q3 2019	Q4 2019	Q1 2020	Q2 2020
5	<i>Eucalyptus moluccana</i>	Mixed	23.2	28.8	15.7	25.8
11	Grasses	Current	<10	15.7	<10	11.1
13	<i>Corymbia maculata</i>	Mixed	35.7	97.8	22.4	90.9
13	<i>Eucalyptus amplifolia</i>	Mixed	<10	29.7	<10	18.4
15	<i>Corymbia maculata</i>	Mixed	37.4	72.5	39.8	23.3
19	<i>Vitis vinifera</i>	Current	<10	<10	Not sampled	Not sampled

# being a deciduous species, *vitis vinifera* had no foliage present at the time of the Q1 & Q2 2020 survey and hence could not be sampled for analysis.

### 4.3 Meteorological Monitoring

Meteorological data is recorded at the meteorological station established at the South East air monitoring location. The station is sited and operated in accordance with approved methodologies (EPA, 2016) for the continuous measurement of wind speed (10 m), wind direction (10 m), sigma theta (10 m) and temperature (5 m). A tipping bucket rain gauge is also deployed to record daily rainfall rates.

The monthly data for temperature and rainfall are provided in **Figure 13**. Monthly wind roses representing the wind speed and direction for the reporting period are provided in **Appendix B**. A summary of the dominant wind patterns throughout the reporting period is provided below.

Review of the monthly wind roses for the reporting period indicates the following:

- In August 2019 winds were blowing predominantly from the northwest;
- From September 2019 to November 2019 winds were blowing predominantly from the northwest and southeast;
- From December 2019 to January 2020 winds were predominantly from the southeast to south with some northwest components;
- In February 2019 winds were predominately from the southeast;
- During March 2020 winds were predominately from the southeast to south with a northwest component
- During April 2020 to July 2020 winds were blowing predominately from the northwest.

Wind speeds recorded over the year were generally low to medium with an average wind speed of 2.0 m/s during the reporting period. The maximum hourly average wind gust during the reporting period was recorded at 11.1 m/s on 7 September 2019.

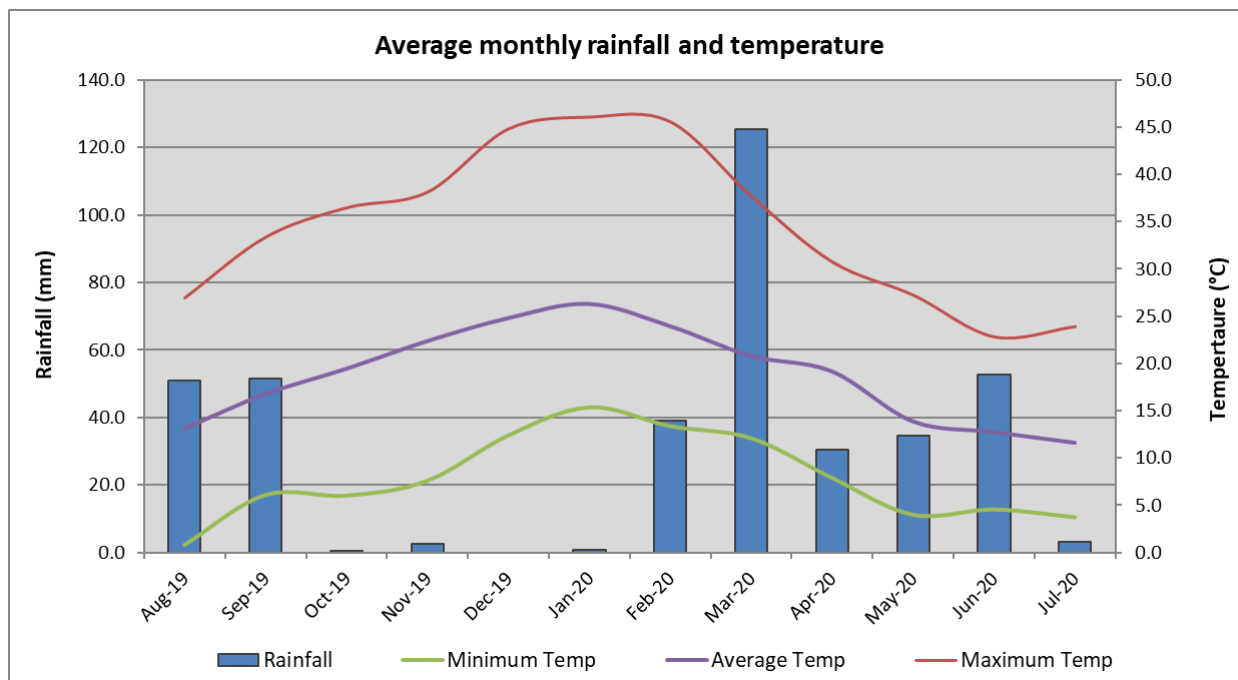


Figure 13 Average monthly rainfall and temperature range (1 August 2019 – 31 July 2020)

#### 4.4 Stack Emissions Testing

Stack emissions testing is undertaken annually in accordance with the EPL requirements. Stack emissions testing was conducted during July 2020. Emission sources assessed during the testing period were those defined in the EPL and listed in **Table 4-7**.

Table 4-7 Emission source descriptions

EPL Identification Number	Emission Source Description
1	Clay Preparation (CP1)
3	Pressing and Drying (PD1)
5	Dryer (D1)
6	Dryer (D2)
9	Glaze Line
10	Selection Line (SL 1,2,3,4)
12	Spray Dryer (SD1)
14	Kiln 1 (KP1)
15	Kiln 2 (KP2)
18	Hot Air Cooler 1 (HAC1)
19	Hot Air Cooler 2 (HAC2)

Each source was tested for Total Particulates and Fine Particulates (PM<sub>10</sub>). Testing conducted on the Kiln 1 and Kiln 2 stacks also measured concentrations of Total Fluoride (as HF), Sulfuric Acid Mist (H<sub>2</sub>SO<sub>4</sub> as SO<sub>3</sub>), Sulfur Dioxide (SO<sub>2</sub> as SO<sub>3</sub>), Total Hazardous Substances (metals), Nitrogen Oxides (NO, NO<sub>2</sub>, NO<sub>x</sub> and Equivalent NO<sub>2</sub>), Cadmium and Mercury. All sampling was conducted in accordance with the applicable EPA test methods with analyses conducted by a NATA-accredited laboratory.

The Project Approval does not specify pollutant concentration limits for the facility. Pollutant concentration limits are specified in Condition L3 of the EPL. Summaries of the emission testing results, along with the EPL pollutant discharge limits, are provided in **Table 4-8** and **Table 4-9**.

All emission concentrations are converted to standard conditions of 0°C, dry gas and 1 atmosphere pressure for comparison with appropriate regulatory limits. The Nitrogen Oxides, Total Particulate and PM<sub>10</sub> emission concentrations from the Kiln stacks are corrected to 18% O<sub>2</sub>.

**Table 4-8 Summary of particulate emission monitoring results (July 2020)**

Stack	Fine Particulate (PM <sub>10</sub> ) (mg/m <sup>3</sup> )	Total Particulate (mg/m <sup>3</sup> )	Regulatory Limit (mg/m <sup>3</sup> )*
Clay Preparation (CP1) (EPL 1)	2.7	6.9	20
Pressing and Drying (PD1) (EPL 3)	4.8	7.4	20
Dryer (D1) (EPL 5)	4.2	19	20
Dryer (D2) (EPL 6)	3.5	4.3	20
Glaze Line (EPL 9)	1.4	2.8	20
Selection Line (SL 1,2,3,4) (EPL 10)	1.2	4.7	20
Spray Dryer (SD1) (EPL 12)	5.8	7.2	20
Hot Air Cooler (HAC 1) (EPL 18)	1.1	4.9	5
Hot Air Cooler (HAC 2) (EPL 19)	2.5	4.0	5

\*Note: Regulatory limit only applies to Total Particulate.

**Table 4-9 Summary of emission monitoring results – Kiln 1 and Kiln 2 (July 2020)**

Pollutant	Kiln 1 (EPL 14) (mg/m <sup>3</sup> )	Kiln 2 (EPL 15) (mg/m <sup>3</sup> )	Regulatory Limit (mg/m <sup>3</sup> )
Fine Particulate (PM <sub>10</sub> ) (at 18% O <sub>2</sub> )	18	18	N/A
Total Particulate (at 18% O <sub>2</sub> )	18	<b>21</b>	20
Gaseous Fluoride (as HF)	4.8	1.4	N/A
Particulate Fluoride (as HF)	0.95	1.5	N/A
Total Fluoride (as HF)	<b>5.8</b>	2.9	5
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> as SO <sub>3</sub> )	21	16	100
Sulfur Dioxide (SO <sub>2</sub> as SO <sub>3</sub> )	160	270	NA
Total Hazardous Substances (Metals)	0.079	0.26	1
Cadmium	0.0073	0.025	0.1
Mercury	0.0024	0.0034	0.1

*Note: **Bold** font indicates an exceedance of the criteria.*

## 4.5 Noise Monitoring

Noise limits set out in NCIA's Project Approval are more stringent than those set out in the EPL and therefore the Project Approval limits are used to assess compliance with noise requirements. The Project Approval states that noise generated from NCIA should not exceed 35 dB(A),  $L_{eq(15 \text{ min})}$  during the day, evening or night periods at the Kenvil Close and Wollombi Road noise monitoring locations (as specified in Condition 26 of the Project Approval). The Project Approval also sets a nighttime sleep disturbance criteria of 45 dB(A)  $L_{max}$ .

Noise levels are measured in accordance with NCIA's Project Approval, EPL, and the procedures set out in the *NSW Industrial Noise Policy* (INP) (EPA, 2000). In accordance with the INP the noise criteria apply under all meteorological conditions except during rain, wind speeds greater than 3m/s (at 10 m above ground level) and intense temperature inversions (greater than +3°/100) between 6 pm and 7 am. Data obtained during these meteorological conditions were omitted.

The noise monitoring was undertaken by AECOM in May 2020. A series of attended noise measurements of 15 minutes duration were made in Kenvil Close and in Wollombi Road on Wednesday 6 May 2020 during the day, evening and nighttime periods. Measurements were also made during the daytime period on the NCIA site. Operator field notes allow for individual noise sources and events to be isolated and the contributions of the various noise sources can then be quantified. At the time of the monitoring operational activities at NCIA were being carried out under typical conditions.

The results of the attended noise measurements at each location and time are summarised in **Table 4-10**.

**Table 4-10 Received noise levels during attended noise monitoring (1 May 2020)**

Location	Time	dB(A), $L_{eq(15 \text{ min})}$	Wind speed / direction	Identified Noise Sources	dB(A), $L_{max}$
Kenvil PI	15:37	53	2.5m/s from the north west	<ul style="list-style-type: none"> <li>Site inaudible</li> <li>Local and highway traffic</li> <li>Dog barking occasionally</li> <li>Birds and insects</li> </ul>	n/a
Kenvil PI	20:42	45	(<1 m/s) and generally from the south west.	<ul style="list-style-type: none"> <li>Unable to determine whether site audible</li> <li>Highway traffic dominant with minimal local traffic</li> <li>Some rail noise</li> <li>Birds and crickets</li> </ul>	n/a
Kenvil PI	23:04	41	(<1 m/s) and generally from the south west.	<ul style="list-style-type: none"> <li>Site barely audible</li> <li>Highway traffic the dominant source</li> <li>Crickets and Birds</li> <li>Paused for passing trains which was the dominant noise source</li> </ul>	n/a
Wollombi Rd	16:12	69	2.5m/s from the north west	<ul style="list-style-type: none"> <li>Site inaudible</li> <li>Noise dominated by traffic on Wollombi Rd</li> <li>Birds</li> </ul>	n/a
Wollombi Rd	20:20	63	(<1 m/s) and generally from the south west.	<ul style="list-style-type: none"> <li>Some industrial noise audible, possibly site generated</li> <li>Regular traffic on Wollombi Rd the dominant source</li> <li>Dog barking in the distance</li> </ul>	n/a

Location	Time	dB(A), L <sub>eq</sub> (15 min)	Wind speed / direction	Identified Noise Sources	dB(A), L <sub>max</sub>
Wollombi Rd	23:31	50	(<1 m/s) and generally from the south west.	<ul style="list-style-type: none"> <li>• Crickets and birds</li> <li>• Site barely audible</li> <li>• Occasional birds</li> <li>• Paused for passing trains and vehicles where possible.</li> <li>• After 8mins the L<sub>Aeq</sub> was 36.9dB which was increased significantly by a passing truck</li> </ul>	n/a

The results show that the measured L<sub>Aeq(15 min)</sub> noise levels at both the Kenvil Place and Wollombi Rd monitoring locations are above the 35 dB(A) Project Approval limit for each of the three time periods.

In most cases traffic was noted to be the dominant noise source with the site noted to be inaudible during the day, potentially audible in the evening and barely audible at night.

In order to determine the noise contribution from the facility alone at the receiver locations, an alternative method of determining compliance, in accordance with the NPI was considered appropriate. In this case site boundary measurements were used to predict noise impacts for each receiver location.

#### 4.5.1 Site Boundary Monitoring

Boundary noise measurements were conducted during the day, evening and nighttime periods at a single location considered to be representative on the eastern boundary of the site. Results from the site boundary monitoring carried out on 6 and 12 May 2020 are presented in **Table 11** below.

**Table 11 May 2020 – Site Boundary Measurement Results**

Location	Time		Measured Noise Level, L <sub>Aeq(15 min)</sub> and L <sub>A90(15 min)</sub> dB(A)		Site Operation
			L <sub>Aeq(15 min)</sub>	L <sub>A90(15 min)</sub>	
Boundary	Day	12/5/20 8:45	52.7	51.5	<ul style="list-style-type: none"> <li>• Site dominant with the majority of noise possibly generated by the stack fans and exhausts</li> <li>• Some intermittent impact noise from site</li> <li>• Trees rustling</li> <li>• Highway traffic occasionally audible</li> <li>• Birds and insects</li> </ul>
	Evening	6/5/20 21:45	49.9	48.8	<ul style="list-style-type: none"> <li>• Plant noise dominant</li> <li>• Insects and crickets</li> <li>• Some other non-site industrial noise from the estate</li> <li>• Highway traffic slightly audible</li> <li>• Paused for passing trains</li> </ul>
	Night	6/5/20 22:04	49.9	48.7	<ul style="list-style-type: none"> <li>• Plant noise dominant</li> <li>• Faint squealing from slow moving train</li> <li>• Insects and crickets</li> <li>• Barking dog in the distance</li> <li>• Paused for passing train</li> </ul>

The results of the site boundary measurements demonstrate there is very little extraneous noise present at this location with the  $L_{A90}$  results relatively close to the  $L_{Aeq}$  results for all three time periods. The  $L_{A90}$  represents the lowest 10% of the noise measured.

#### 4.5.2 Predicted Noise Levels

In order to predict resultant noise levels at each receiver from the NCIA facility alone, a 'flat ground' model was used based on hemispherical spreading, conservatively assuming no topographical shielding, ground or air absorption, directivity or meteorological effects. Calculated noise levels at each receiver location are presented in **Table 12**.

**Table 12 May 2020 – Calculated Noise Levels at the Receiver Locations**

Receiver Location	Time	Calculated noise impact, dB(A)	Project Approval Limit, dB(A)	Comply
Kenvil Place	Day	37	35	Yes*
	Evening	34	35	Yes
	Night	34	35	Yes
Wollombi Road	Day	34	35	Yes
	Evening	32	35	Yes
	Night	32	35	Yes

\* Calculated noise level within 2dB of statutory noise limit and considered negligible as per the NPI

Calculated results show that with the exception of the Kenvil Place daytime result, all predicted results are below the 35dB Project Approval limit at both receiver locations.

A result within 2dB of the criteria was calculated at the Kenvil Place receiver for the daytime period with a 2dB exceedance considered negligible by the NPI. The calculation also assumes a flat ground model with direct line of site between the source and receiver. In this case the site is not visible from Kenvil Place, with a significant amount of infrastructure between the site and this location as well as a line of trees at the site boundary. In addition, the site was noted to be inaudible at Kenvil Place during the daytime measurement period further demonstrating that it is likely the site contribution at the Kenvil Place receiver is compliant with the 35dB limit.

#### 4.5.3 Assessment Against Short-Term Nighttime Criteria

Both the Project Approval and EPL state that a 45dB short term limit applies during the nighttime period (10pm – 7am). The Project Approval stipulates the  $L_{AMax}$  must not exceed 45 dB at the two receiver locations (Kenvil Place and Wollombi Road) while the EPL stipulates that the  $L_{A1}$  must not exceed 45 dB at the nearest residential receiver most affected by noise from activities at the premises (deemed to be 26 Fairway Street).

$L_{AMax}$  measurements performed at the Project Approval locations were elevated due to localised noise sources and are not representative of the site contribution. While a  $L_{A1}$  measurement was not directly obtained at 26 Fairway Street, the  $L_{AMax}$  measured at this location was 47 dB, The  $L_{AMax}$  reading is a shorter time period than the  $L_{A1}$  and provides a conservative assessment of short term noise potentially impacting sleep. An exceedance within 2 dB of the criteria is considered negligible under NPI and it is likely that an  $L_{A1}$  result if available would be compliant. For reference the  $L_{A10}$  result of 42dB at this location is below the criteria.

Due to the proximity of the Fairway Street location to the site (357m) and the significant distance between the two Project Approval locations and the site (1050m and 1350m), a compliant result at Fairway Street implies the  $L_{AMax}$  is also compliant at both the Kenvil Place and Wollombi Road locations.

## 4.6 Water

### 4.6.1 Water Usage

Water usage at NCIA is principally for use in the tile manufacturing process and wash down requirements. Water is also required for staff amenities, landscaping and firefighting if required.

Although there is no regulatory limit on water usage, Schedule 3 Condition 44 of the Project Approval stipulates that NCIA needs to seek approval from Hunter Water Corporation (HWC) before its water consumption is expected to exceed 92ML/year.

NCIA used a total of approximately 51.4 ML of process water during the current reporting period. This is well below the threshold value of 92ML/year for which HWC approval is required.

### 4.6.2 Stormwater Quality

Stormwater quality is monitored on a weekly basis within Pond 4, which is located in the South East corner of the site. The channel outlet connected to Pond 4 is the location of potential stormwater discharge from the site. Monitoring is therefore undertaken within Pond 4 in order to ascertain water quality data in the event of such discharge occurring. Monitoring started in 2009 and is ongoing with the following parameters monitored: pH value, Electrical Conductivity (EC) (as a measure of salinity) and water temperature, as well as visual observations of turbidity levels, odour and colour.

The results of the stormwater quality monitoring during the reporting period for pH and EC are presented in **Figure 14** and **Figure 15** respectively. For assessment purposes the monitoring results are compared against the *ANZG Guidelines for Fresh and Marine Water Quality* (ANZG 2018). The adopted ANZG 2018 guidelines for pH and conductivity are the default trigger values for slightly disturbed aquatic ecosystems in NSW lowland rivers. The data for the current monitoring period shows that:

- pH values ranged between 7.3 and 10.3 with a varying trend throughout the reporting period. Results generally exceeded the ANZG guidelines.

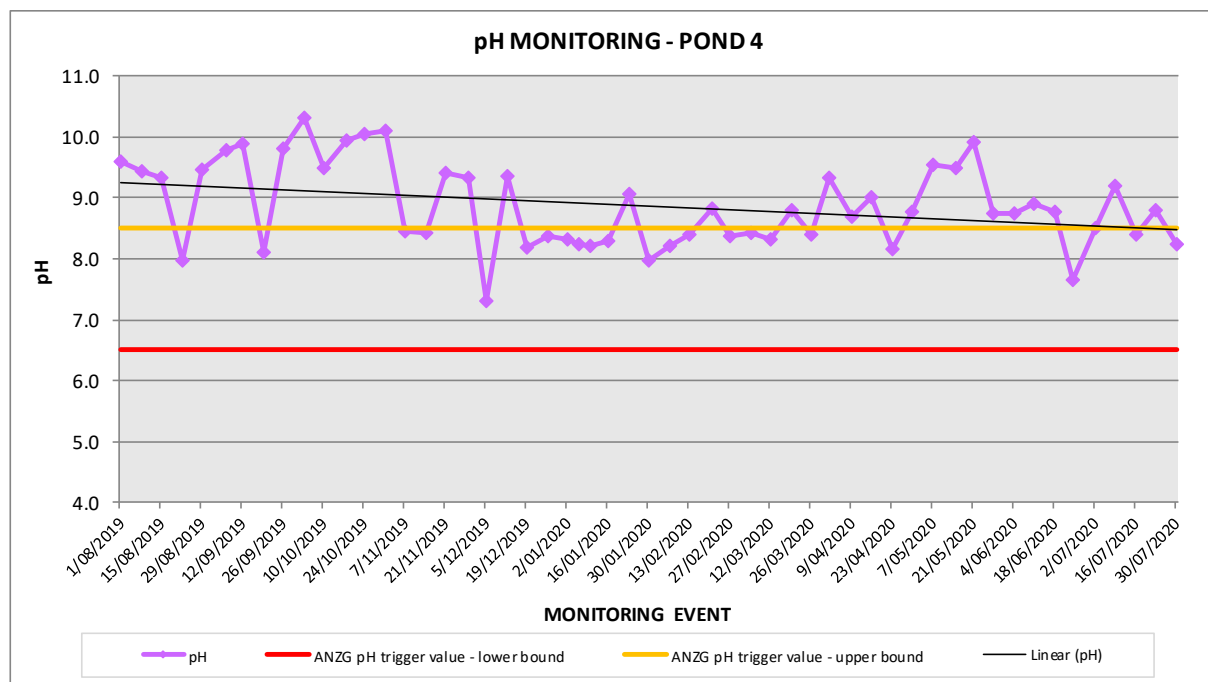


Figure 14 Stormwater quality monitoring – pH



- EC values were low and show a very slight decreasing trend throughout the reporting period with levels generally around 400 to 500  $\mu\text{S}/\text{cm}$  indicating that the water is non-saline. The EC values were within the ANZG guidelines for the entire reporting period with the exception of 19/03/2020 which was not included in the data set.

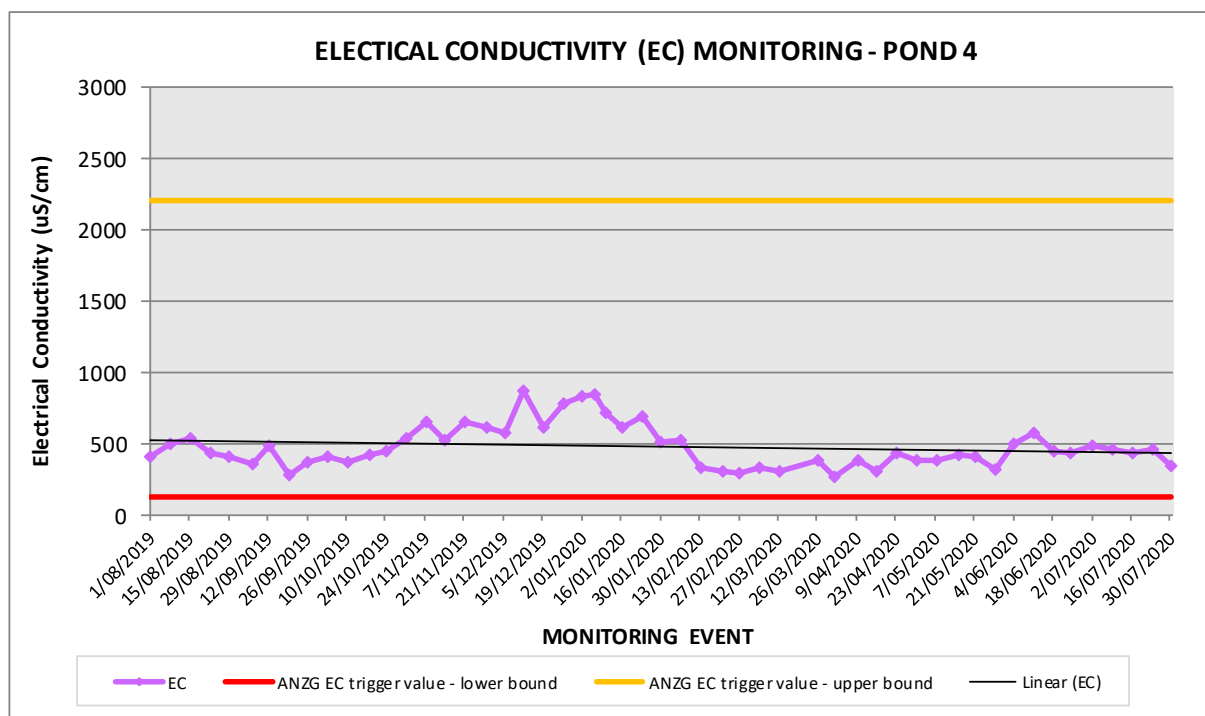


Figure 15 Stormwater quality monitoring – EC

#### 4.7 Waste Generation

There are no regulatory requirements in terms of waste generation quantities, types or production efficiency targets pertaining to NCIA's operations. The Project Approval simply stipulates that a designated area for the storage and collection of waste and recyclable material must be provided at the facility (Schedule 3 Condition 52). Designated areas are provided on site for the storage of fired waste and other wastes (e.g. general office and packaging wastes) in accordance with the requirements of the Project Approval.

The main waste generated from the operation is tile waste. Tile waste comprises both green tiles (i.e. raw material waste from unfired tiles) and broken fired tiles. Other types of waste generated from the facility include consumables, packaging waste and general domestic waste generated within the office and lunchroom; however, these wastes represent an extremely minor part of the total waste stream.

The amounts of tile waste generated during the current reporting period (shown as a proportion of the total tile production) are presented in **Figure 16**.

NCIA's targets for tile wastes were lowered in July 2018 to not exceed 1% (for green tile waste) and 7% (for fired tile waste) of the total tile production, respectively. From January 2020 the amount of green waste has increased as a result of capturing more defective product prior to firing resulting in all 2020 months exceeding the green tile waste target. It must be noted that all green waste is recycled. The increased capture of green waste has resulted in the amount of fired tile waste reducing significantly from a monthly average of 10.1% recorded in the previous reporting period to a monthly average of 8.0%. with only seven months exceeding the target in the 2019-20 reporting period



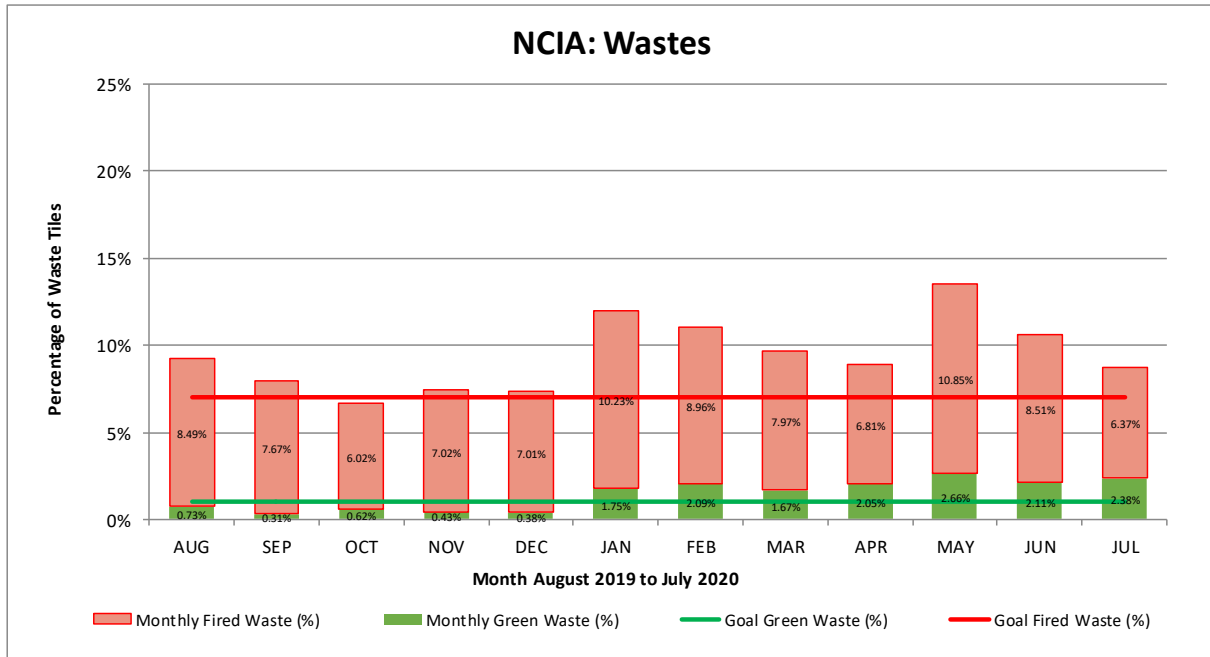


Figure 16 Tile waste (green and fired) generation during 2019-2020

## 5.0 Discussion of Environmental Performance

This section provides an assessment of the monitoring results for the reporting period against the criteria set out in the Project Approval and EPL, predictions made in the 2010 EA, and the monitoring results from previous years. Trends observed in the monitoring results or discrepancies between predicted and actual impacts are discussed.

### 5.1 Ambient Air Quality

The 2010 EA predicted that, with the exception of PM<sub>10</sub>, emissions from NCIA would meet all of the ambient air criteria. The 2010 EA stated that existing background 24-hour PM<sub>10</sub> concentrations already exceeded the EPA criterion. While it was predicted that the annual average PM<sub>10</sub> criterion would be met, the 2010 EA indicated that the 24 hour average PM<sub>10</sub> concentrations may exceed the criteria under worst case dispersion conditions. Specifically, predictions made in the 2010 EA for the project included the following:

- The maximum cumulative 24 hour average PM<sub>10</sub> concentration at the closest existing private receptor was predicted to be 53.4 µg/m<sup>3</sup> (compared to the criterion of 50 µg/m<sup>3</sup>);
- The maximum cumulative 24 hour average PM<sub>10</sub> concentration for residential receptors within the Heritage Parc subdivision (located at 99 Racecourse Road, Rutherford) was predicted to be 57.7 µg/m<sup>3</sup> (compared to the criterion of 50 µg/m<sup>3</sup>);
  - The cumulative impact of predicted maximum PM<sub>10</sub> concentrations at all existing residential receptors was considered to be minor despite the predicted cumulative results being above the guidelines. It was not expected that the predicted PM<sub>10</sub> impacts would be beyond levels already experienced due to the minor contribution of the project when compared to the elevated background PM<sub>10</sub> levels;
  - No exceedances of 24 hour or weekly Fluoride concentrations at existing residential receptors were predicted;
  - The maximum cumulative 24 hour Fluoride concentration for future residential receptors within Heritage Parc was predicted to be 3.2 µg/m<sup>3</sup> (compared to the criterion of 2.9 µg/m<sup>3</sup>); and
  - The above exceedance of the 24 hour Fluoride criterion was predicted during a worst case scenario with NCIA operating all eight Stages. Only two Stages of the development are currently operational.

Ambient air quality monitoring during the reporting period (presented in **Section 4.1**) indicated that the levels of 24 hour PM<sub>10</sub>, annual average PM<sub>10</sub>, 24 hour fluoride and weekly fluoride were generally compliant with the relevant guidelines criteria, with five exceedances of the 24 hour PM<sub>10</sub> criteria of 50 µg/m<sup>3</sup> recorded. NCIA were not considered to be a major contributor to any of these exceedances (as discussed in **Section 4.1.1**). The monitoring results for the reporting period are considered to be consistent with the predictions made in the 2010 EA.

Historical ambient air monitoring results recorded since commencement of operations (15 March 2004 to current) are shown in **Figure 17** to **Figure 22**. An analysis of historical trends in air pollutant concentrations (and where relevant comparisons against the current reporting period) reveals the following:

- Historical PM<sub>10</sub> concentrations are variable with results generally oscillating around a relatively stable annual average and isolated elevated concentrations occurring episodically. PM<sub>10</sub> concentrations during the 2020 reporting period were consistent with historical data and there is a decreasing linear trend in PM<sub>10</sub> concentrations, which is more apparent at the NW monitoring location compared to the SE monitoring location.
- Following seven years of relatively low and steady levels of fluoride emissions between 2004 and 2011 (despite isolated and episodic increases), gaseous fluoride levels have slightly increased since 2012 in both the 24-hour and weekly fluoride levels. Fluoride emissions during the 2020

reporting period were similar to the previous five years. Nonetheless, there is an overall increasing linear trend in 24 hour and weekly fluoride levels at both monitoring locations.

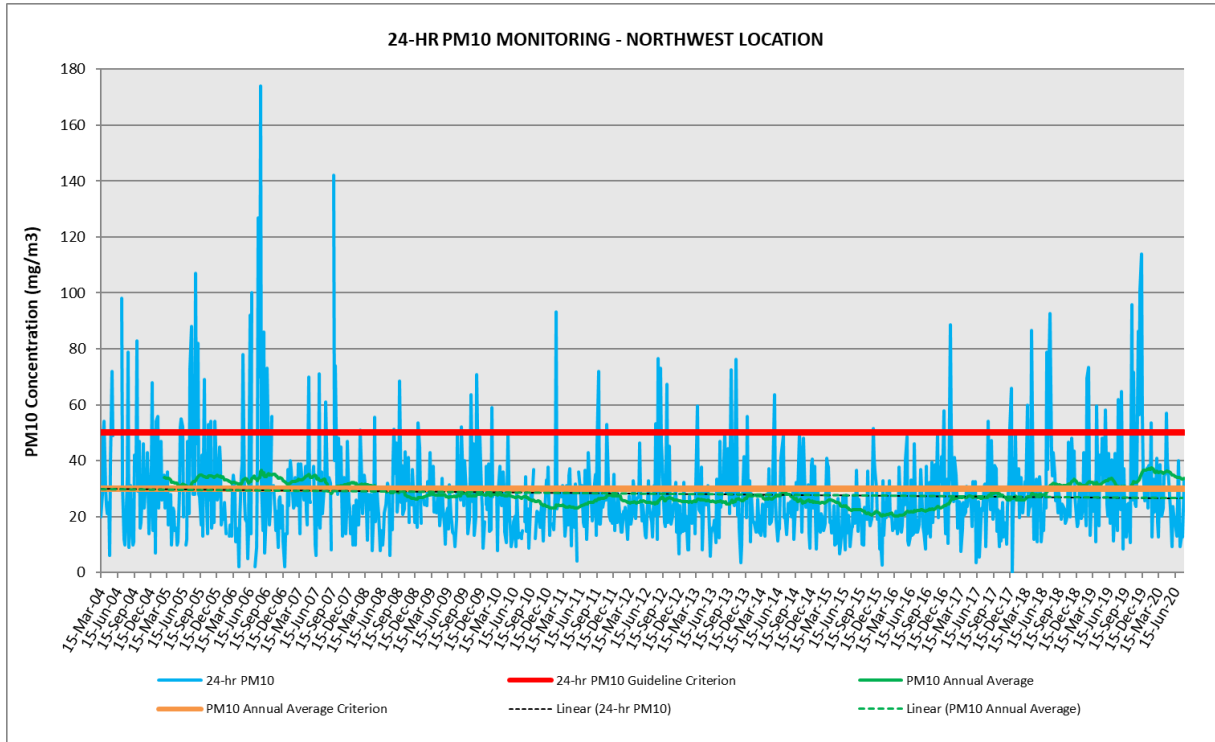


Figure 17 24-hour PM<sub>10</sub> monitoring – northwest location (2004 – 2020)

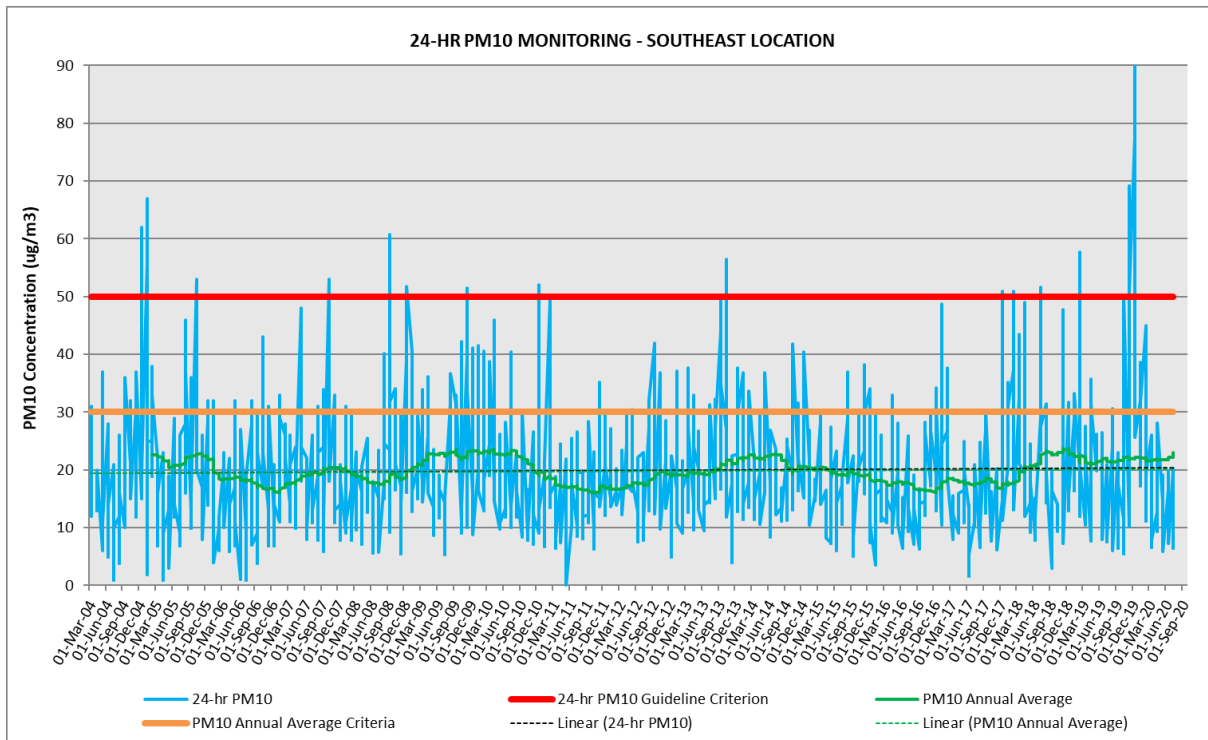


Figure 18 24-hour PM<sub>10</sub> monitoring – southeast location (2004 – 2020)

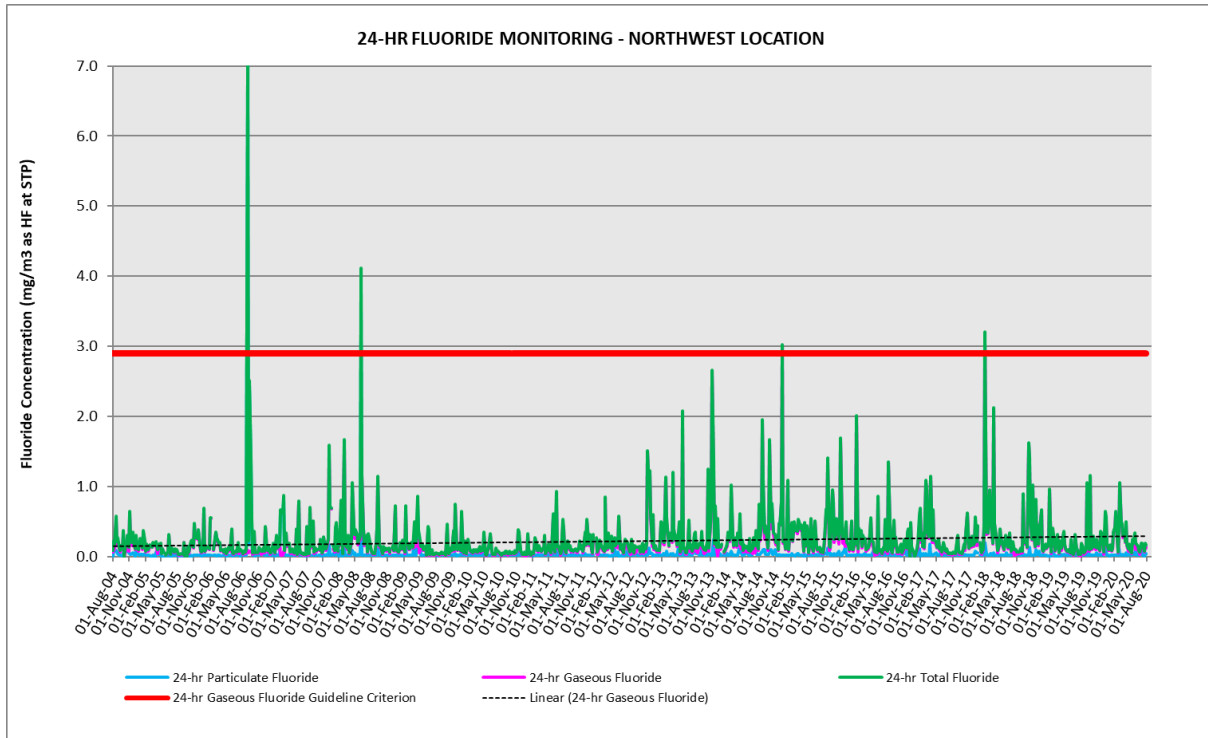


Figure 19 24-hour fluoride monitoring – northwest location (2004 – 2020)

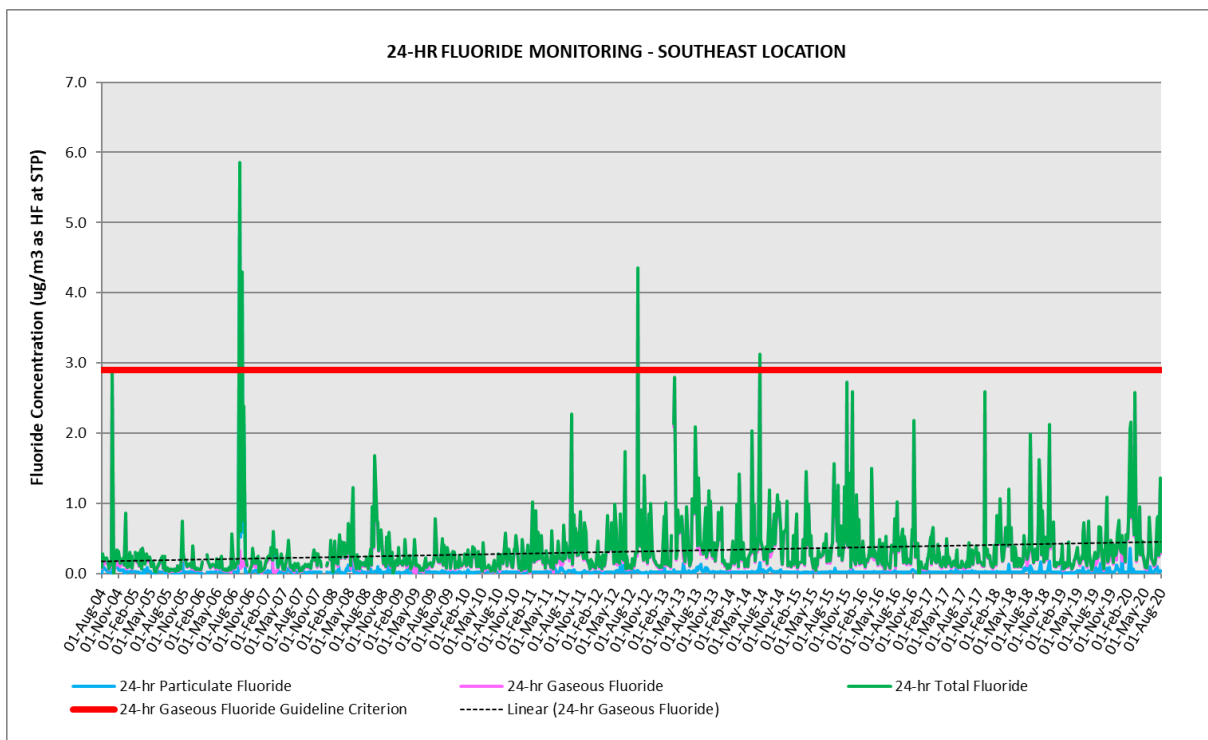


Figure 20 24-hour fluoride monitoring – southeast location (2004 – 2020)

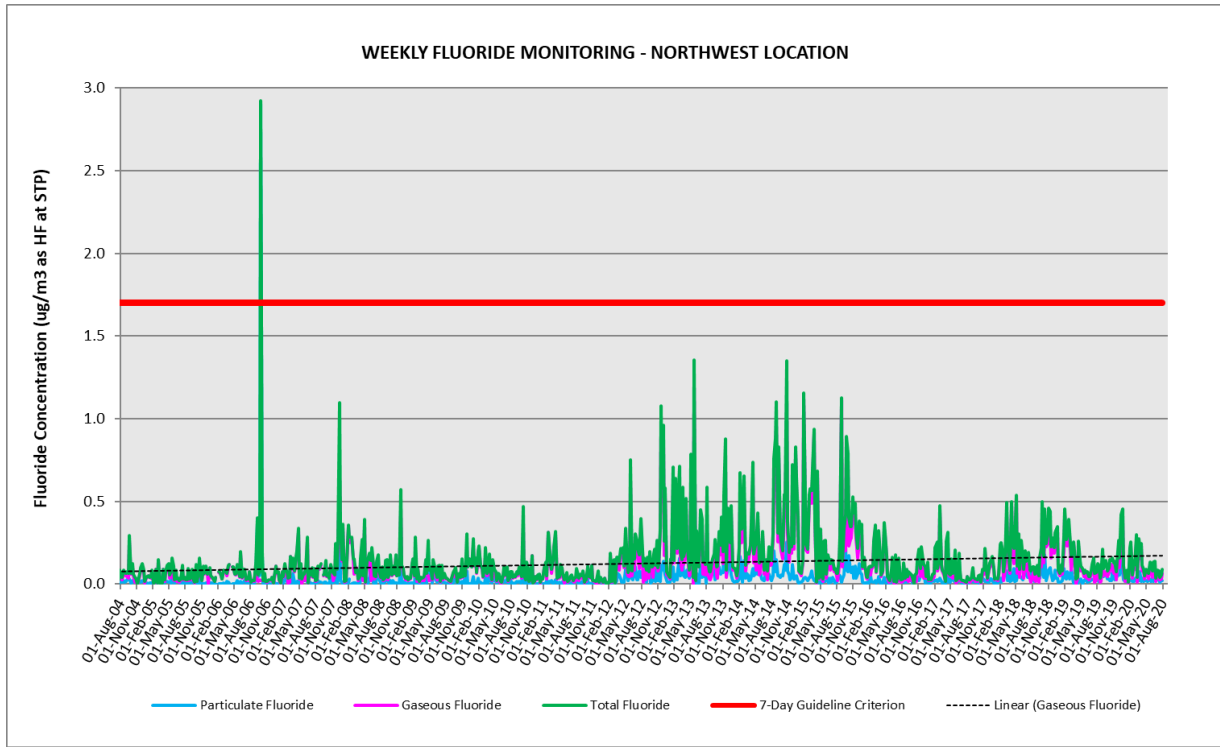


Figure 21 Weekly fluoride monitoring – northwest location (2004 – 2019)

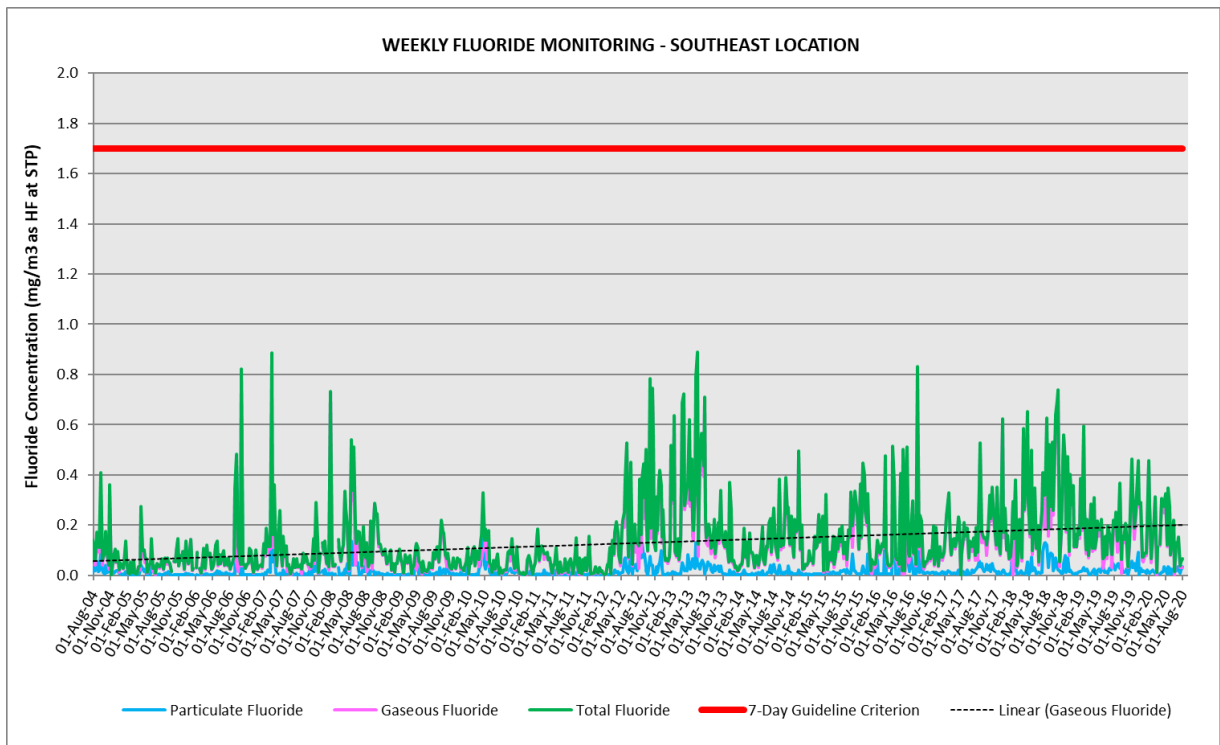


Figure 22 Weekly fluoride monitoring – southeast location (2004 – 2020)

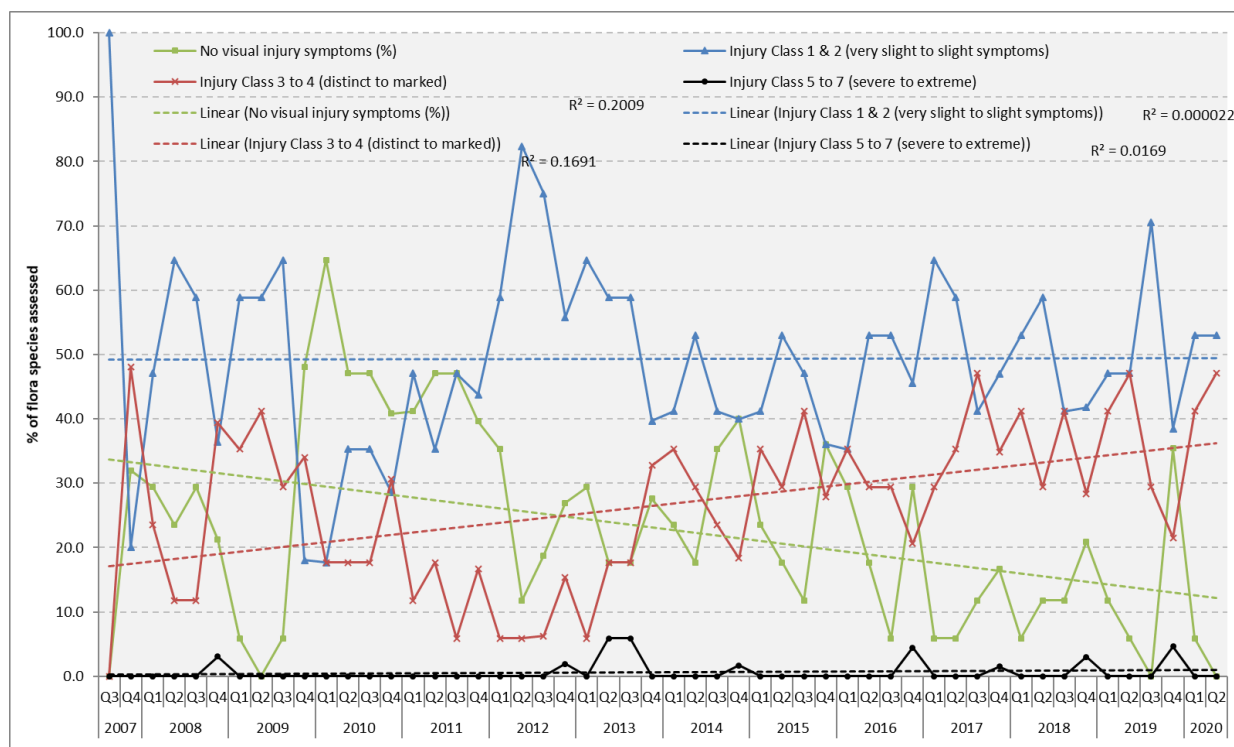
## 5.2 Fluoride Impact on Vegetation

As required by the EPL the potential impact of NCIA’s operations on vegetation surrounding the facility is monitored through assessment of fluoride impacts on local vegetation, including visual assessments of injury symptoms to leaves and foliar fluoride content. There are no limits or criteria set out in the EPL or Project Approval by which to assess compliance. Likewise, the 2010 EA did not specifically discuss fluoride impact on vegetation and therefore no predictions are available for comparison. Instead, the assessments are used to provide an indication of trends in fluoride injury and concentrations at set locations surrounding the facility and for a suite of particular species.

### 5.2.1 Trends in Visual Impact on Vegetation

Historical results for vegetation visual assessments since the start of the monitoring program are presented in **Figure 23**. For each quarterly survey the data has been presented to show the proportion of total species assessed that were impacted by fluoride related injury symptoms of varying severity. The results were grouped into the following four categories (also refer to **Table 4-4** in **Section 4.2** for definitions of injury classes):

- Species showing no visible fluoride injury symptoms;
- Species displaying at worst class 1 (very slight) or class 2 (slight) injury symptoms;
- Species displaying at worst class 3 (distinct) or class 4 (marked) injury symptoms; and
- Species displaying class 5 injury symptoms and above (severe to extreme).



**Figure 23 Proportion of flora species affected by emission related visual injury symptoms (2007-2020)**

Despite clear seasonal variations, historical data show little long-term variability in the severity of fluoride impacts to vegetation surrounding the NCIA facility. The data supports no statistically significant increase or decrease in the severity of injury symptoms since the start of the monitoring program (as justified by the correlation  $r^2$  values for all severity classes being  $<0.2009$ ).

Interrogation of the long term monitoring data indicates the following:

- The majority of flora species assessed since the start of the monitoring program have commonly displayed at least some level of fluoride related injury symptom (87% on average during each quarterly survey). Of all plants showing emission related impacts to foliage:
  - On average 49% displayed very slight or slight visual injury symptoms (i.e. less than 5% of leaf area affected) and 27% displayed distinct or marked fluoride injuries (i.e. between 10% and 25% of leaf area affected);
  - Severe injury symptoms (i.e. 25–50% of leaf area impacted) have rarely been recorded during the monitoring program (eight instances in a total of 1351 observations since 2007) and where this has been the case, injury symptoms did not persist; and
  - Only three instances of very severe injury symptoms (i.e. 50-75% of leaf area impacted) have been recorded throughout the monitoring program and extreme injury symptoms (i.e. greater than 75% of leaf area impacted) have never been recorded.
- The majority of flora species assessed since the start of the monitoring program have commonly displayed at least some level of insect attack injury symptoms (approximately 77% of all species affected on average). Of all plants showing impacts from insect attack: injury severity was very slight in 24% of cases, slight in 26% of cases, distinct in 20% of cases, marked in 7% of cases and severe in less than 1% of cases.

The monitoring data obtained during the current reporting period (as presented in **Section 4.0**) are generally well aligned with these long term trends. As is commonly observed, this year's results have shown some minor variations in foliage condition against previous year's results, with some specimens showing either slight deteriorations or slight improvements in foliage condition (whilst most showed relatively consistent symptoms). None of this year's survey results could be flagged as exceptional in the context of the long-term monitoring program and associated historical data.

### 5.2.2 Trends in Fluoride Content in Vegetation

Historical fluoride concentrations in vegetation sampled during each of the quarterly and annual surveys are presented in **Figure 24** to **Figure 27**.

Overall foliar fluoride concentrations for the samples collected during this monitoring period's surveys were consistent with the long-term range of data for all species at all locations. The following comments apply to this year's results when compared against previous year's data:

- Historic data for *E. moluccana* at Site 5 indicates that there is typically a seasonal increase in foliar fluoride concentrations during spring (Q3) or summer (Q4) before levels settle down during autumn (Q1) and winter (Q2), which reflects changing dominant wind patterns occurring with the change of season. Overall, this year's foliar fluoride concentrations values in this species were within the lower range of historical values.
- Samples of grasses collected at Site 11 consistently returned low fluoride contents (i.e.  $\leq 10.0 \mu\text{g/g}$ ) during the current reporting period, which is consistent with the long term results (**Figure 25**). Seasonal increases in fluoride concentration are commonly observed in grasses at this location in response to changing wind patterns. Historical records show that fluoride concentrations often peak during Q2 or Q3 (i.e. in late spring or winter when winds have been dominated by north-westerlies blowing towards the monitoring site from the NCIA kiln stacks).
- Sampling results of *E. amplifolia* at Site 13 during the current reporting period were within the medium to low range of historical values for this species (**Figure 26**).
- The long term trend in this specimen emphasises the high seasonal / annual variability and relative unpredictability in foliar fluoride concentrations in individual species.
- Consistent with long term data, fluoride concentrations in the foliage of *C. maculata* at Site 13 have been relatively low throughout the current reporting period (i.e. generally below  $12.0 \mu\text{g/g}$ ).

- Foliar fluoride concentrations in *C. maculata* at Site 15 observed an episodic fluoride concentration peak (120 µg/g), being common in this species, peak during Q4 2018, with the remaining quarters containing low range of historical values (**Figure 27**). Historical records indicate a very high variability in fluoride content for this species since 2007, with a seemingly stochastic and unpredictable pattern that appears independent from seasonal wind changes.

Historical data show wide fluctuations in foliar fluoride content between quarterly surveys, and it is common for fluoride concentrations to experience and display episodic increases on a seasonal basis, usually reflecting the changing dominant wind patterns occurring with the change of season. On the longer term however, there seems to be a distinguishable annual pattern in fluctuating fluoride concentrations and historical data shows that for each species fluoride concentrations tend to oscillate within a set range of values.

The long-term data shows that there is an obvious variability in the sensitivity of tree species and individuals to the impacts of atmospheric fluoride with different individuals' clearly absorbing varying levels of atmospheric fluoride through their leaf tissue.

It is also possible that environmental and climatic conditions play a role in foliar fluoride concentration levels – for instance higher rainfall may lead to emission particulates deposited on leaves being quickly washed from the leaf surface, and therefore not able to be absorbed and accumulated in the leaf tissue.



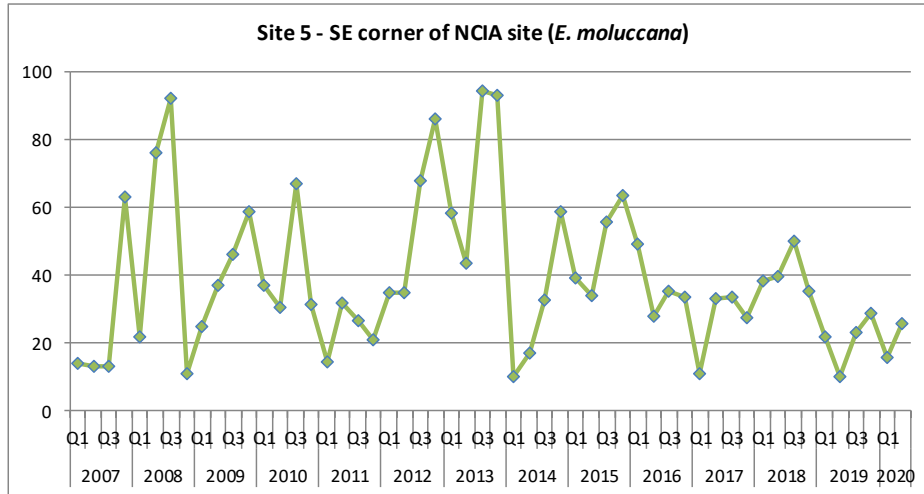


Figure 24 Fluoride content in *E. moluccana* foliage at Site 5 (Q1 2007 – Q2 2020)

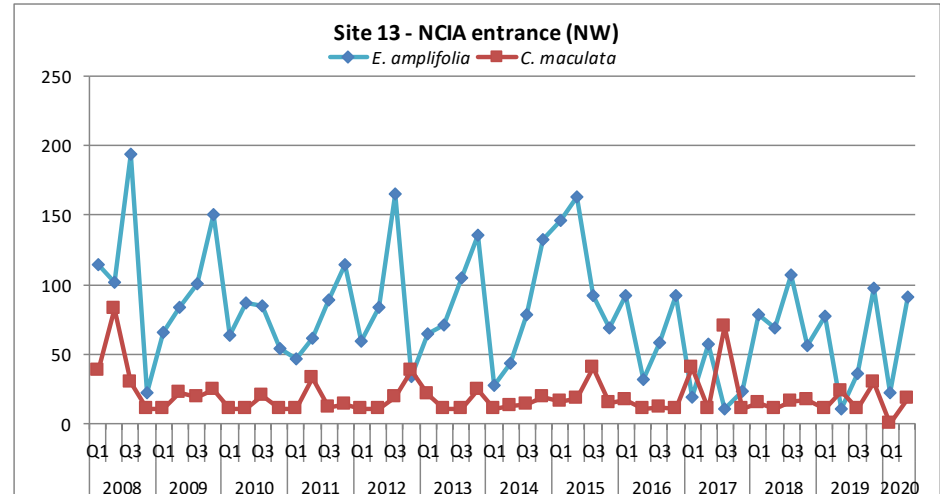


Figure 26 Fluoride content in *E. amplifolia* and *C. maculata* foliage at Site 13 (Q4 2007 – Q2 2020)

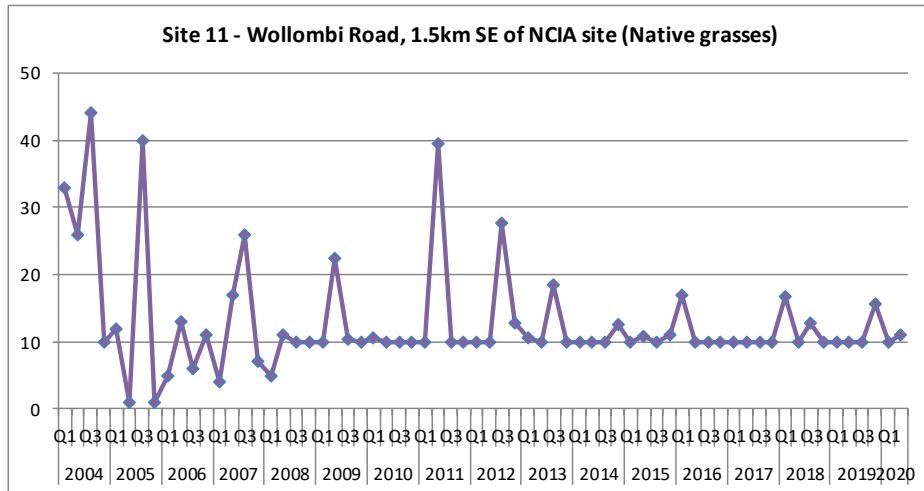


Figure 25 Fluoride content in grasses at Site 11 (Q1 2004 – Q2 2020)

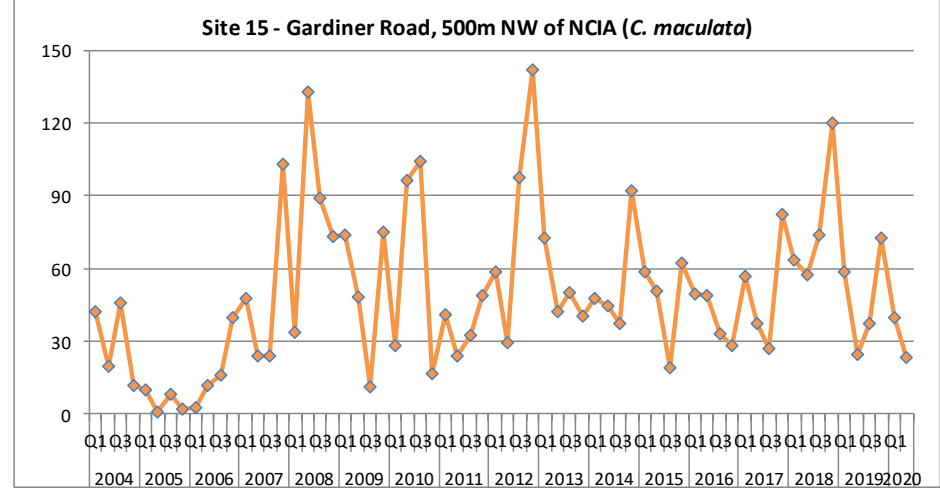


Figure 27 Fluoride content in *C. maculata* foliage at Site 15 (Q1 2004 – Q2 2020)

### 5.2.3 Reference Site

The reference site is located approximately 3 km to the north of the NCIA facility thus outside the prevailing wind direction. Given its location, it is expected that there should be no impacts to the vegetation as a result of fluoride emissions.

Long term results of the visual assessments of foliage injury symptoms undertaken at this location show that vegetation has historically been in good and healthy condition. However, some injury symptoms have commonly been recorded over the years, particularly symptoms of cupping and tip necrosis, albeit of very slight severity, as well as insect attack injuries. The link to fluoride emission as a cause for these symptoms cannot be confidently determined for this monitoring location. It is possible that some species will exhibit foliar injury symptoms under 'natural' conditions. Other factors may play a role in the expression of injury, which may include environmental conditions, stress (e.g. drought, wind, diseases, etc.), and pollutants from other sources or impacts from insects.

Given the social and economic importance of the viticultural industry in the Hunter Valley the potential impact of atmospheric pollutant emissions from industrial sources on the health of the grape vine *Vitis vinifera* (a known sensitive species) has traditionally been a concern for the industry. Consequently, foliar sampling and analysis of *Vitis vinifera* foliage from the reference site has historically been included as part of this vegetation monitoring program. Historical concentrations since the commencement of the monitoring programme are presented in **Figure 28**.

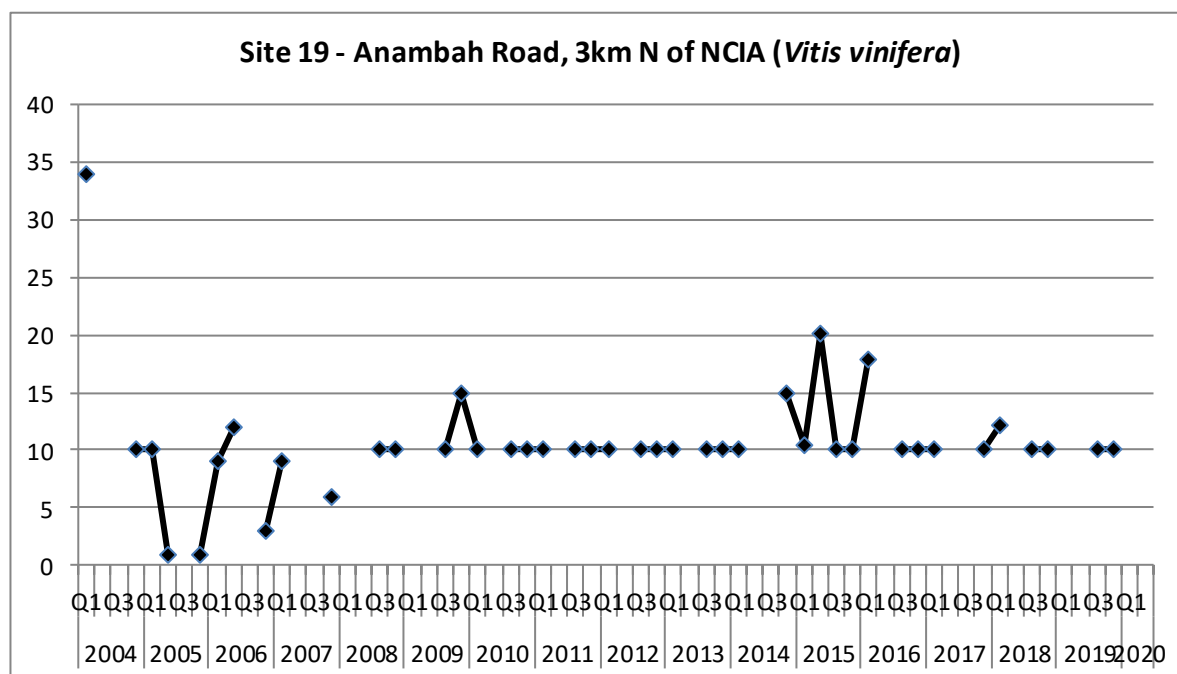


Figure 28 Fluoride content in *Vitis vinifera* foliage at Site 19 (Q1 2004 – Q2 2020)<sup>2</sup>

Long term data show that foliar fluoride has consistently returned very low concentrations for this species (<10.0 µg/g).

Recurrent elevated fluoride levels were recorded in the species between Q4 2014 and Q1 2016 (**Figure 28**). As noted in last year’s AEMR, the property at the reference site underwent significant maintenance during that period, including the re-instatement of a functional irrigation system. Some scientific literature suggests that the use of municipal water injected with fluoride (which is the case in Australia) used for irrigation can result in toxicity symptoms on sensitive plants such as grape vines (Psheidt, 2015). In this regard the elevated fluoride levels returned during that period may have been linked to the maintenance activities (and irrigation) undertaken on site. However, fluoride concentration

<sup>2</sup> Note that the breaks in the line result from leaf samples not being collected and analysed for a particular quarter due to the absence of foliage on the vine (i.e. the species is deciduous).

levels recorded in the grape vine appear to have stabilised during the previous and current reporting periods which indicates that the species may have adjusted to the new irrigation water.

#### 5.2.4 Relationship between Visual Symptoms and Foliar Fluoride Content

The results of the vegetation surveys undertaken during the reporting period together with historical data seem to indicate a poor correlation between foliar fluoride content and the visible expression of injury symptoms in foliage. For instance, although the *E. amplifolia* at Site 13 commonly returns the highest fluoride concentrations its foliage only shows very slight visible injury symptoms (and notably no chlorosis symptoms). Conversely, the foliage of *C. maculata* at the same location consistently exhibits distinct fluoride visual injury symptoms while the laboratory results show that its foliar fluoride concentrations are the lowest of all tree species sampled. The discrepancy between visual injury symptoms and foliar fluoride concentrations may be due to:

- A lag in the visible expression injury symptoms following exposure to atmospheric fluoride emissions;
- Varying sensitivity of individual specimens in exhibiting visible injury symptoms; and/or
- Emissions related visual injury symptoms being ‘mimicked’ by natural environmental impacts such as climatic conditions and insect attack.

Overall, there is an inherent level of unpredictability in the expression of visual symptoms between monitoring events as well as an obvious variability in sensitivity to fluoride impacts both inter and intra-species, with different individuals clearly being more resistant or sensitive to emission related impacts than others.

### 5.3 Meteorological Monitoring

NCIA have been monitoring the local meteorological conditions in accordance with Condition M5 – Weather Monitoring of the EPL. **Table 5-1** demonstrates the percentage uptime of monitoring equipment achieved throughout the reporting period. The meteorological monitoring equipment achieved continuous monitoring of 99.9% for wind speed, 99.3% for wind direction, 93.8% for ambient temperature and 93.7% for rainfall during the reporting period.

**Table 5-1 Meteorological station up-time**

Meteorological Parameter	Frequency	Percentage up-time during reporting period
Wind speed @10m (m/s)	Continuously	99.9%
Wind direction @ 10m (degrees)	Continuously	99.3%
Sigma theta @ 10m (degrees)	Continuously	99.9%
Ambient temperature @ 5m (degrees Celsius)	Continuously	93.8%
Rainfall (mm)	Continuously	93.7%

## 5.4 Air Pollutant Load Limits

The 2010 EA included dispersion modelling to predict ground level pollutant concentrations. The source emission concentrations used in the modelling (Table 17 of the 2010 EA) were based on the results of stack emission testing conducted between 2007 and 2009. A comparison of the measured in stack emission concentrations for the reporting period and the emission concentrations used in the 2010 EA modelling is provided in **Table 5-2**. The results are variable - some of the measured emission concentrations during the reporting period are lower than the emission concentrations used in the 2010 EA modelling, and some are higher than those used in the 2010 EA modelling. However, where measured stack concentrations were higher than those used in the 2010 EA, these did not result in an exceedance of the EPL criteria (refer to **Section 4.4**) with the exception of total fluoride for Kiln 1.

Trends in the air quality pollutants discharged to air as a result of NCIA operations over time can be established using the assessable pollutant loads reported to the EPA in the Annual Returns since 2003. The actual load of assessable pollutants reported in the Annual Returns is calculated in accordance with the relevant Load Calculation Protocol for ceramics production. **Table 5-3** provides the assessable pollutant loads discharged by NCIA during the reporting period. The maximum load limits set out in both the EPL and Project Approval and the historical pollutant loads discharged (2004-present) have also been included for comparison purposes and are presented graphically in **Figure 29** to **Figure 33**.

The load limits specified in the Project Approval and EPL differ. Condition 16 of the Project Approval states:

*Unless the OEH specifies otherwise, the Proponent shall ensure that the annual total load discharged from the site does not exceed the load limit specified for that pollutant in Table 3.*

As the EPA has 'specified otherwise' by specifying different load limits in the EPL (that are equivalent to Stage Two operations), the load limits in the EPL prevail over those in the Project Approval.

For the current reporting period, fine particulates (PM<sub>10</sub>), coarse particulates, sulfur oxides and nitrogen oxides were all within the pollutant load limits. However, fluoride discharged to air exceeded the EPL load limit during the reporting period. This is likely to be due to the normal variability in process and annual stack testing results. It is noted that all weekly and 24 hour fluoride ambient monitoring to the North West and South East of the facility returned results below the relevant EPA guideline criteria.

Historical data show that there is a high level of variability in pollutant emissions between reporting years with no clear trend or consistency in results. These fluctuations are likely due to the normal variation in stack emission testing results. This renders difficulty in any comparison of this year's emission results against the long term data. The following points are made in relation to the current load limit results:

- PM<sub>10</sub> emissions recorded an increase in levels from the previous reporting period, with levels remaining below the permitted EPL load limit;
- Coarse particulate emissions increased in levels from the previous reporting period, with levels less than the permitted EPL load limits;
- The total amount of fluoride discharged during reporting period was below the EPL load limit with fluoride emission levels the lowest reported levels in the previous five years.
- The sulfur oxides pollutant load was similar to or slightly higher than previous reporting periods and was less than that permitted under the EPL; and
- The nitrogen oxides pollutant load was similar to previous reporting periods and well below the permitted load limits.

Table 5-2 Comparison of emission concentrations used in 2010 EA modelling and measured in stack emission concentrations for the current reporting period

Source	Emission Concentration (mg/m <sup>3</sup> )							
	Fine particulate (PM <sub>10</sub> )	Total Particulate	Total Fluoride (as HF)	Sulfuric acid mist (H <sub>2</sub> SO <sub>4</sub> as SO <sub>3</sub> )	Total Hazardous substances (Metals)	Total Oxides of Nitrogen	Cadmium	Mercury
Kiln 1 (EPL 14)	<b>18</b> (5.3)	18 (5.3)	<b>5.8</b> (5.0)	<b>21</b> (9.6)	0.079 (0.2)	29 (50.0)	<b>0.0073</b> (0.003)	0.0024(0.01)
Kiln 2 (EPL 15)	<b>18</b> (5.3)	21 (5.3)	2.9 (5.0)	16 (9.6)	0.26 (0.2)	25 (50.0)	<b>0.025</b> (0.003)	0.0034 (0.01)
Clay preparation (CP1) (EPL 1)	2.7 (2.0)	6.9 (2.3)	-	-	-	-	-	-
Pressing and Drying (PD1) (EPL 2)	4.8 (2.5)	7.4 (4.8)	-	-	-	-	-	-
Dryer (D1) (EPL 5)	4.2 (8.4)	19 (12.8)	-	-	-	-	-	-
Dryer (D2) (EPL 6)	3.5 (8.4)	4.3 (12.8)	-	-	-	-	-	-
Glaze Line (EPL 9)	1.4 (1.9)	2.8 (4.3)	-	-	-	-	-	-
Selection Line (SL 1,2,3,4) (EPL 10)	1.2 (6.3)	4.7 (6.3)	-	-	-	-	-	-
Spray Dryer (SD1) (EPL 12)	5.8 (13.1)	7.2 (13.1)	-	-	-	-	-	-
Hot Air Cooler 1 (HAC1) (EPL 18)	<b>1.1</b> (0.3)	4.9 (2.3)	-	-	-	-	-	-
Hot Air Cooler 2 (HAC2) (EPL 19)	<b>2.5</b> (0.3)	4.0 (2.3)	-	-	-	-	-	-

Note – Emissions concentrations used in 2010 EA modelling are shown in parentheses.

**Bold** text identifies where measured in stack emission concentrations during the reporting period are greater than emission concentrations used in 2010 EA modelling.

Table 5-3 Maximum pollutant load limits and assessable pollutant loads

Pollutants loads		Pollutant				
		Fine particulates (PM <sub>10</sub> )	Coarse particulates	Fluoride	Sulfur oxides <sup>3</sup>	Nitrogen oxides
Current Maximum Load Limit (kg)	EPL	26,629	14,338	1,850	36,828	36,828
Actual Load (kg) in reporting period	2019-2020	12,966	4,482	1,563	6,678	18,293
	2018-2019	7,140	8,346	<b>2,076</b>	5,699	20,996
	2017-2018	10,145	2,878	<b>2,239</b>	6,059	25,165
	2016-2017	13,028	5,800	<b>2,411</b>	14,835	19,023
	2015-2016	5,816	11,310	<b>4,146</b>	16,835	21,360
	2014-2015	4,963	2,302	1,400	15,240	24,016
	2013-2014	5,369	3,289	928	4,280 <sup>4</sup>	25,059
	2012-2013 <sup>1</sup>	1,249	1,640	1,109	1,235 <sup>4</sup>	4,704
	2011-2012	997	5,550	91	26,946	20,306
	2010-2011	2,902	1,774	295	7,699	18,322
	2009-2010 <sup>2</sup>	6,524	475	621	<b>86,704</b>	<b>79,375</b>
	2008-2009	5,476	2,564	1,529	<b>70,565</b>	<b>62,426</b>
	2007-2008	4,449	3,881	336	16,633	18,073
	2006-2007	7,289	12,657	<b>1,989</b>	15,850	12,423
	2005-2006	21,751	11,986	<b>4,085</b>	13,239	13,887
2004-2005	4,034	2,100	<b>2,154</b>	21,335	6,721	
2003-2004	1,028	1,089	150	5,813	1,151	

*Bold represents an exceedance*

<sup>1</sup> The Project Approval came into effect on January 2013 and the previous Consent was relinquished.

<sup>2</sup> 2009-2010 marked the commencement of stage 2 of the development.

<sup>3</sup> Sulfur oxides (as sulphuric acid mist and sulfur trioxide (as SO<sub>3</sub>)).

<sup>4</sup> Sulfur oxide loads for the 2012-13 and 2013-14 reporting years have been corrected to only include sulfuric acid mist and sulfur trioxide, as agreed with regulatory authorities, and not sulfur dioxide as previously calculated and reported.

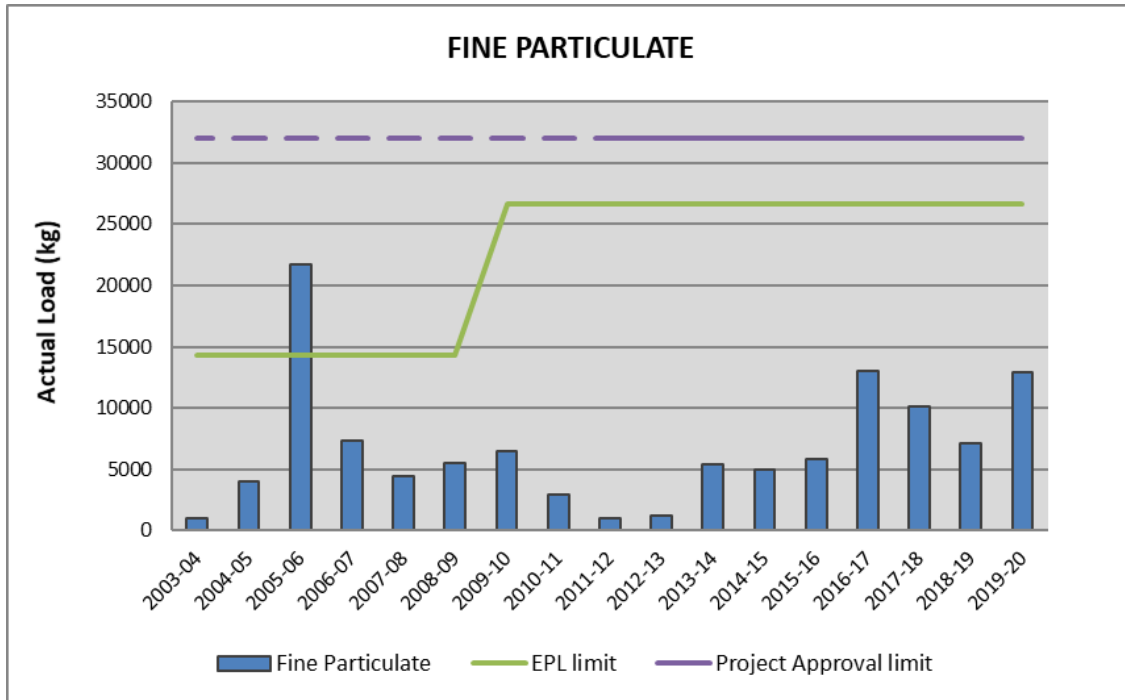


Figure 29 Fine particulate annual load (2004 – 2020)

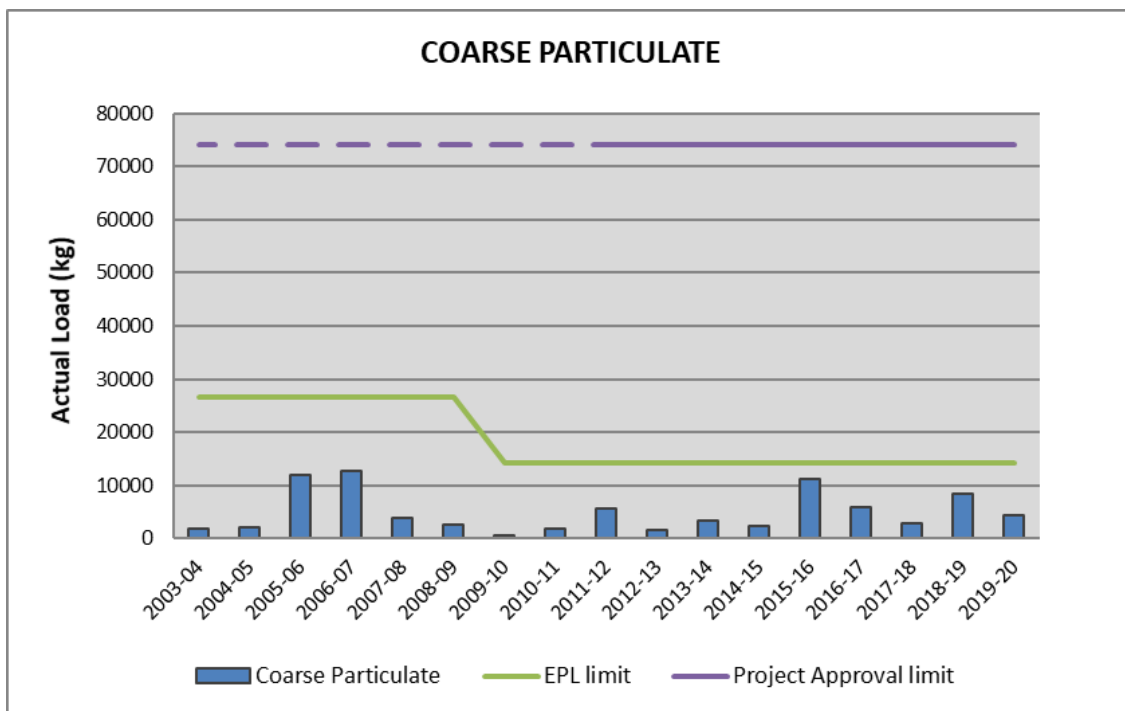


Figure 30 Coarse particulate annual load (2004 – 2020)

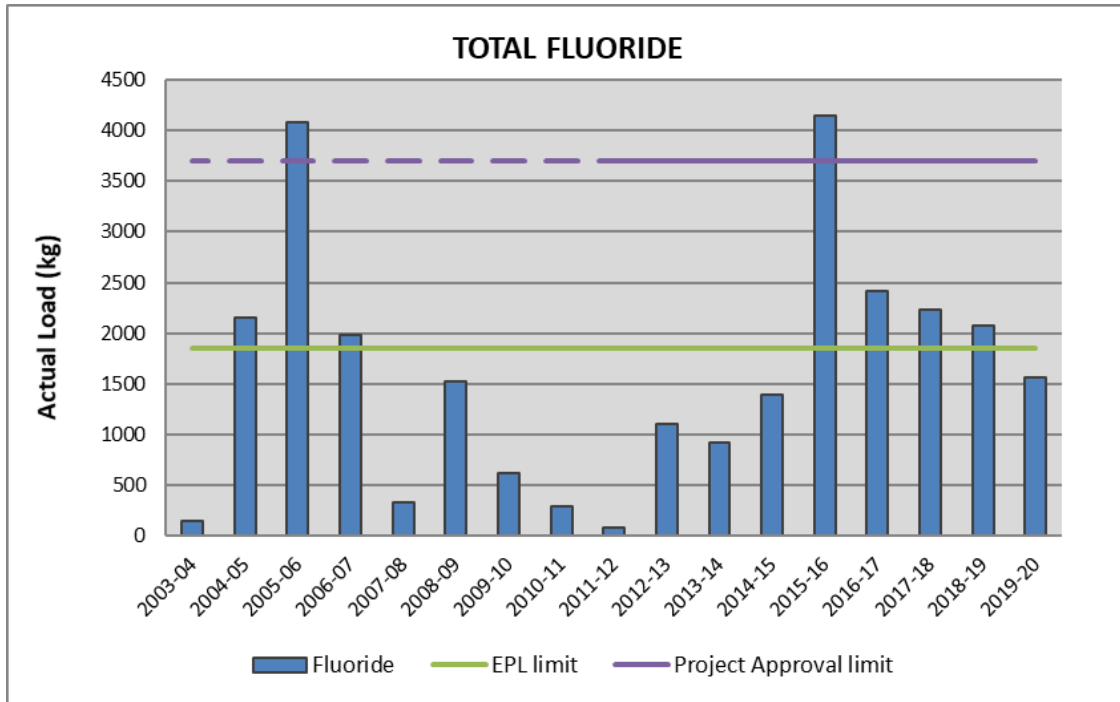


Figure 31 Fluoride annual load (2004 – 2020)

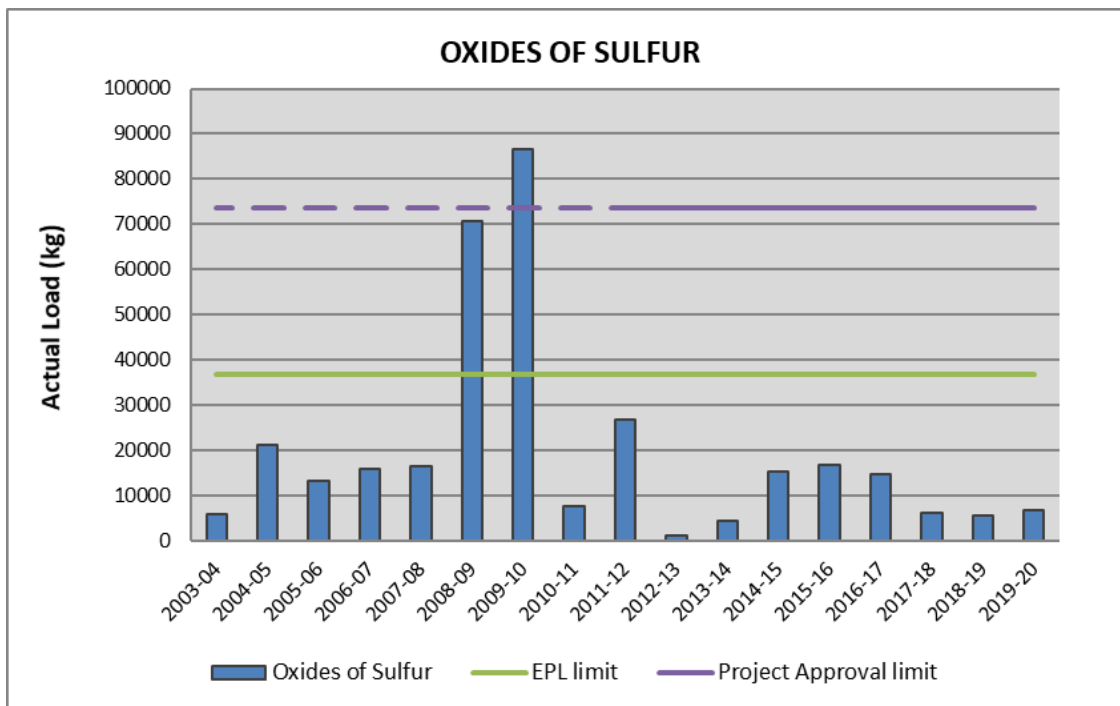


Figure 32 Sulfur oxides (as sulphuric acid mist and sulfur trioxide (as SO<sub>3</sub>)) annual load (2004 – 2020)

Note: Sulfur oxide loads for the 2012-13 and 2013-14 reporting years have been corrected to only include sulfuric acid mist and sulfur trioxide, as agreed with regulatory authorities in 2012, and not sulfur dioxide as previously calculated.



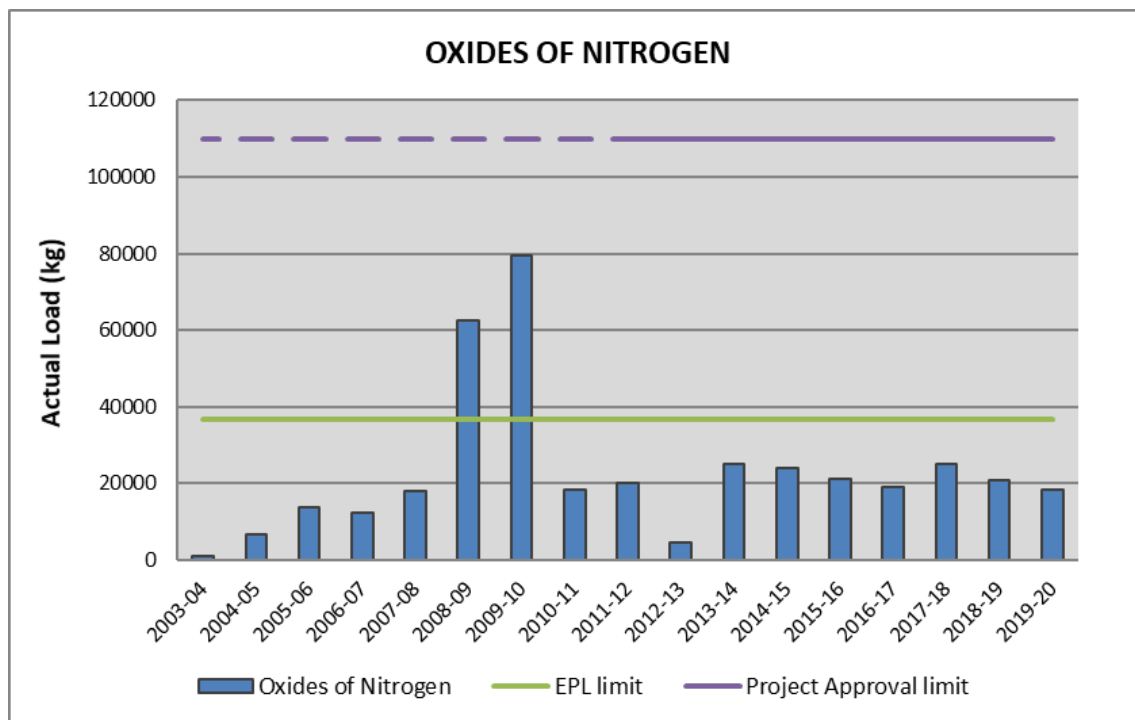


Figure 33 Nitrogen oxides annual load (2004 – 2020)

## 5.5 Noise

The 2010 EA indicated that the increase in background levels in the Rutherford region was likely to be due to the development of new industrial facilities in the Rutherford Industrial Estate. The 2010 EA predicted that the operational noise levels from the expanded facility would not change considerably from that already approved and would be below the project specific noise criteria at all existing receptors under calm and prevailing weather conditions.

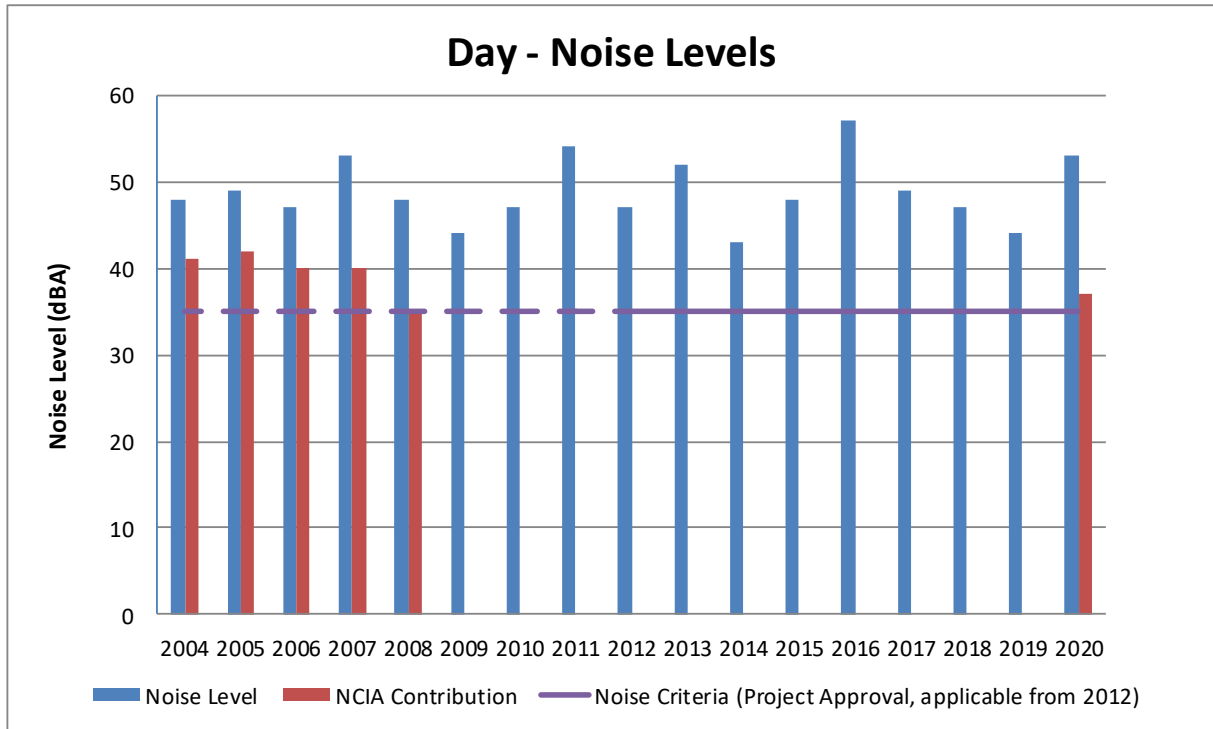
The Project Approval specifies more stringent noise limits than those set out in the EPL. Under the Project Approval noise generated from NCIA must not exceed 35 dB(A) for the day, evening and night periods.

Monitoring results for the reporting period indicate that noise emissions from NCIA were in compliance with the Project Approval noise criteria for all time periods, including the sleep disturbance criteria.

Historical noise monitoring results at the Kenvil Close monitoring location are provided in **Figure 34 – Figure 36** for the day, evening and night periods respectively. On many occasions NCIA was not clearly audible over other dominant nearby industrial and traffic noise sources.

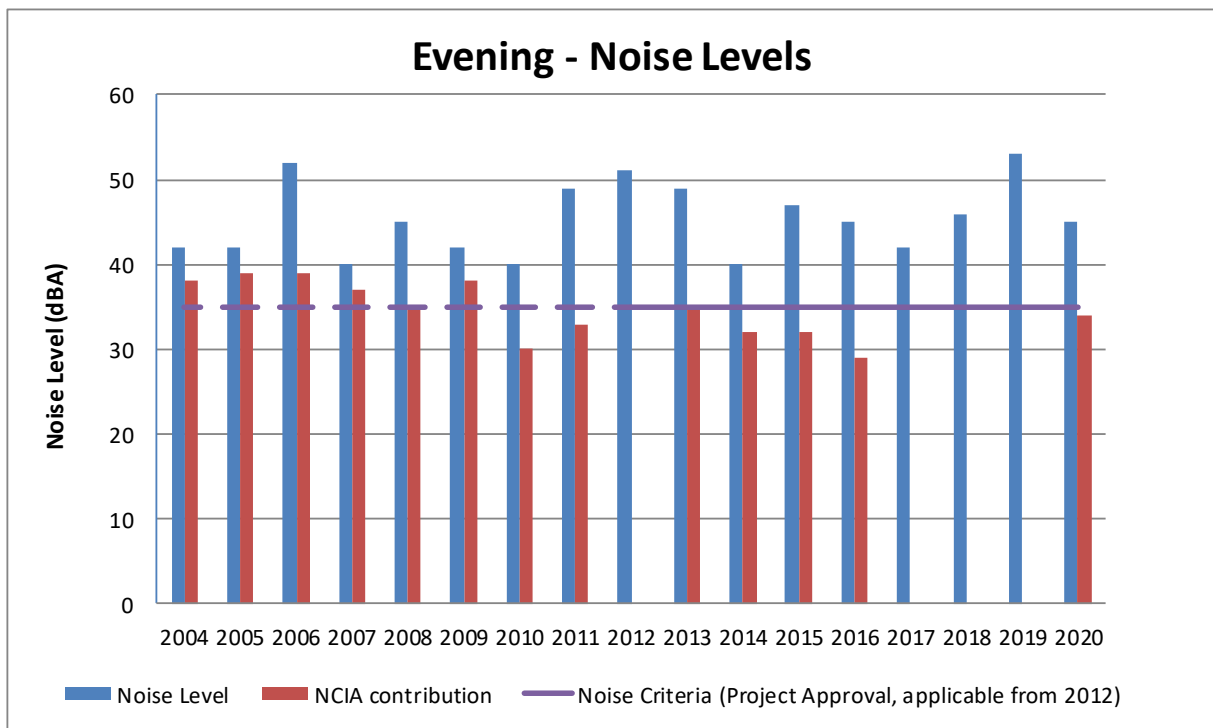
No trends in the noise monitoring are clearly discernible with historical noise emissions generally complying with noise limits. No exceedance of the day, evening or night criteria has been recorded since 2009. Regarding the 2dB exceedance shown in **Figure 34**, it should be noted that calculated noise levels within 2dB of statutory noise limit are considered negligible as per the NPI.

The current noise monitoring report noted that traffic noise from the New England Highway contributed significantly to the background noise levels at Kenvil Close.



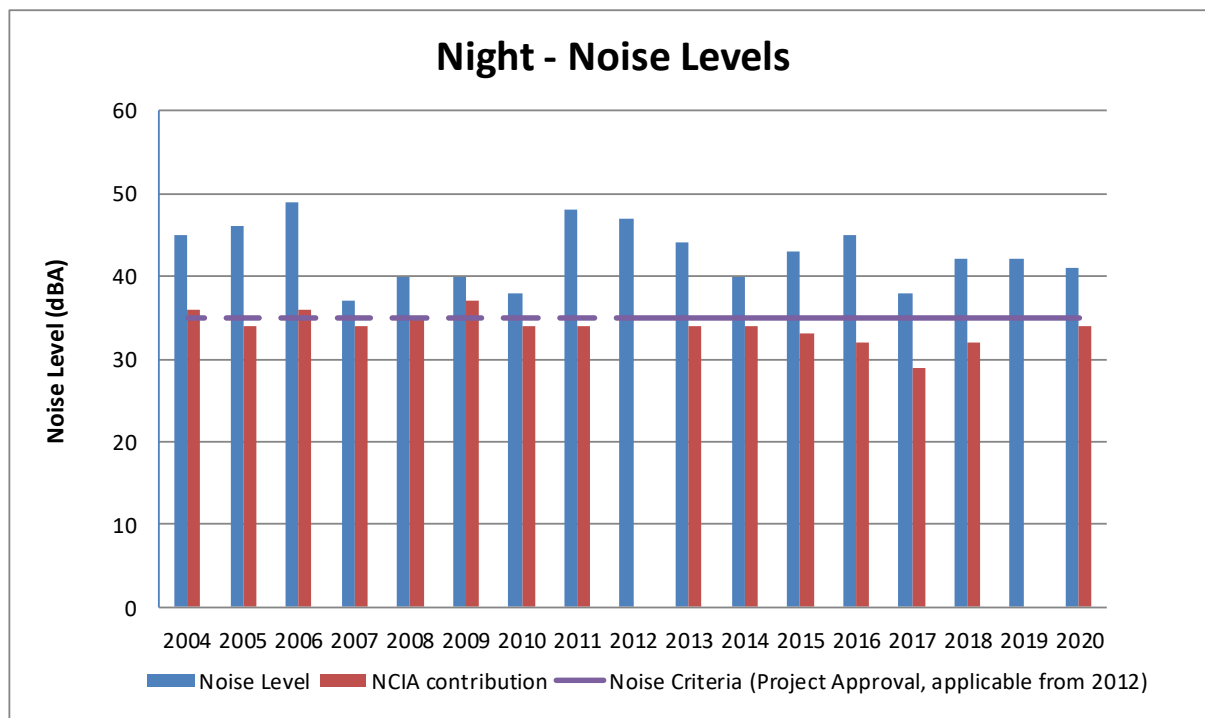
Note 1: 2009 - 2019: NCIA contribution was either inaudible or not measurable.

Figure 34 Day noise levels 2004 – 2020



Note: 2012, 2017, 2018 and 2019: NCIA contribution was either inaudible or not measurable.

Figure 35 Evening noise levels 2004 – 2020



Note: 2012 and 2019: NCIA contribution audible but not measurable.

Figure 36 Night noise levels 2004 – 2020

## 5.6 Water

### 5.6.1 Water Usage

The 2010 EA indicated that water consumption for the facility during Stages One–Four of the development would be approximately 1,772kL per week (approximately 92ML per annum). Stages Five–Eight of the development would be expected to use an equivalent volume of potable water as Stage One–Four for a cumulative expected consumption of up to 3,544kL per week (approximately 184ML per annum).

Consumption of potable water during the reporting period August 2019 to July 2020 was approximately 51.4 ML. The consumption of approximately 51.4ML of potable water is proportionally within the predictions of the EA given that only Stages One–Two were operational. NCIA have held preliminary discussions on site with Hunter Water representatives regarding potential Water Saving Initiatives.

It is anticipated that the 92ML/year threshold usage over which NCIA will require HWC approval will not be reached until further stages of development are constructed and commissioned. Regardless, consultation with HWC was started during the 2010 EA process in provision of future developments. NCIA will resume the consultation process as required when further development stages are planned.

### 5.6.2 Process Water Management

As the requirement for water from NCIA has the potential to place stress on the town-water reticulation system (particularly during periods of drought), NCIA has endeavoured to minimise its reliance and demand for town water. Particularly, all process and wash-down water is recycled within the operation of the facility.

The NCIA facility does not discharge process or washdown water to the storm water system. Water used for process requirements is only discharged in the form of steam to the atmosphere. Approximately 95% of all washdown water is captured within an internal reticulation system and recirculated for reuse as process water. The remaining 5% of washdown water evaporates.

Apart from discharges to the sewer from staff amenities there is no discharge of process or washdown water from the site other than as steam. Materials stored for the manufacturing process are housed within the building to ensure that there are no spills from the site.

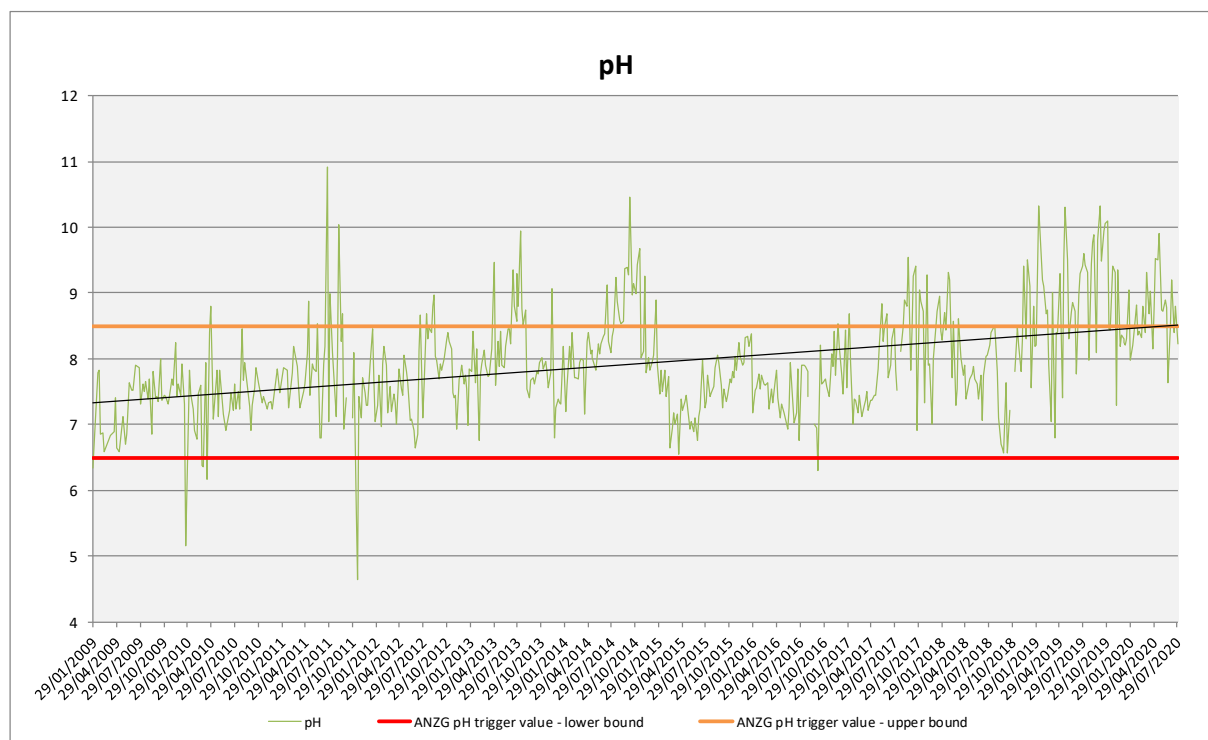
Plant equipment operated at NCIA is maintained regularly and in accordance with manufacturer’s specifications to ensure that water use, reuse and recycling efficiencies are optimised. The consumption of water is continually monitored via metering systems associated with plant equipment.

**5.6.3 Stormwater Quality**

Historical trends (2009-present) in water quality for pH and EC are presented in **Figure 37** and **Figure 38**, respectively. The 2010 EA made no provision of stormwater quality performance measures or indicators.

Long term data shows that pH levels in pond 4 have generally been on a slowly increasing trend since 2009, with the exception of the past two reporting periods. On occasion since 2009 recorded pH values occurred beyond the ANZG pH trigger values, with the upper threshold limit exceeded more often than the lower limit (refer to **Figure 37**), highlighting a trend towards alkalinity. This trend has continued during the current reporting period with 31 monitoring events showing pH results higher than the ANZG trigger values (refer to **Section 4.6.2**).

EC results during 2020 are comparable to previous years with a stable average and no exceedances of the criteria (refer to **Figure 38**). A review of historical EC values indicates an overall decreasing trend. EC values are generally within the ANZG guidelines trigger values and indicate that the stormwater is non-saline.



**Figure 37 Stormwater quality, pH – Pond 4 (2009-2020)**

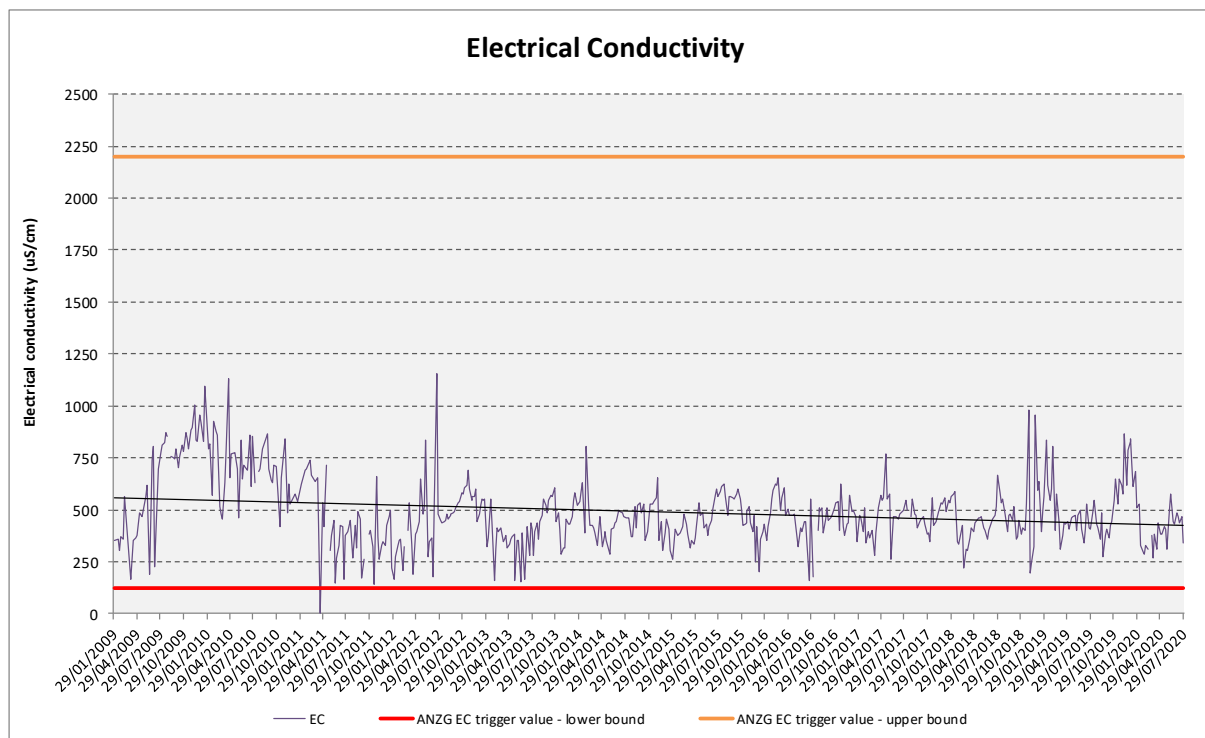


Figure 38 Stormwater quality, EC – Pond 4 (2009-2020)

#### 5.6.4 Stormwater Management

The stormwater management system was designed to minimise the changes to the flow regime from Stages One–Four of the project. The management of stormwater at NCIA is achieved via four water detention basins which are connected by grass swales (managing surface water flows from roof, roadway and landscaped areas) and a series of pits and pipe work (servicing the car park and hardstand areas).

The grass swales have been designed to control surface flow velocities from runoff areas to no greater than 2 m/s. Final low flow stormwater discharges from the site occur at the channel outlet, located at the south eastern corner of the site (connected to Pond 4). Discharged storm water then connects directly to the existing neighbouring artificial wetland. Pond 4 was noted to be discharging on four occasion throughout the reporting period on 19 September 2019, 13 February, 26 March and 30 July 2020. Pond 4 water parameters were all within relevant criteria on these dates.

The detention basins have been designed with sufficient retention to reduce peak stormwater flows and improve the quality of water ultimately discharged from the site. The combined surface area of the four water detention basins is approximately 6,600 m<sup>2</sup>, which represents approximately 6.6% of the total catchment area. This exceeds the minimum requirement of 2% permanent water area defined in the *Constructed Wetlands Manual* (DLWC, 1998). As such, the level of water treatment offered by the wet detention system surpasses the guideline requirements.

As detailed in the 2010 EA, the existing stormwater management system will be modified and expanded if and when development Stages Five–Eight are constructed and commissioned.

## **5.7 Waste**

### **5.7.1 Waste Generation**

The 2010 EA stated that based on production levels at the time, approximately 1% of all fired tiles were not eligible for sale (either as broken tiles or not passing NCIA's strict quality assurance process). That figure was used to estimate the total amount of fired waste tile at maximum production rate (i.e. with Stages One – Eight operational) and predicted that approximately 2,720 tonnes of fired tiles waste would be generated per annum. The 2010 EA did not predict or specify the amount of green tile waste to be generated by the project.

The amount of fired tile waste during the reporting period (monthly average of 8.0% of total production) was higher than the predictions made in the EA, however close to NCIA's current operation target of 7% and down on previous years.

Monthly green tile waste levels have consistently been low and are below the 1% target throughout the reporting period until January when green tile waste levels increased above the 1% target due to more defect product being captured before firing. NCIA continues to focus on reducing waste and increasing operational efficiency.

### **5.7.2 Waste Management**

One hundred percent of green tile waste generated during production is reused in the manufacturing process and as such does not enter the overall waste stream leaving the site. Fired waste is stored in a bunker on site ensuring that it is free of cardboard and other debris. It is ultimately reused in the construction industry for road base material and other developments which greatly minimises the total amount of waste NCIA sends to landfill.

All other waste (i.e. packaging waste, general office waste and lunchroom waste) is collected by a licenced recycling or waste contractor. Incoming packaging waste such as pallets are reused wherever possible.

## 6.0 Non-Compliances

### 6.1 2019-2020 Non-Compliances Record

There were 18 non-compliances were recorded during the 2019-2020 reporting period. Details relating to the non-compliances and the actions taken to investigate or to prevent a recurrence are summarised in **Table 6-1**.

**Table 6-1 Details of non-compliance with EPL or Project Approval conditions during the 2019 reporting period**

Condition No / Reference	Details of Non-compliance	Action taken
<b>Non-compliances recorded during the reporting period</b>		
EPL Condition L3.4	<p>Annual stack emissions testing identified two exceedances.</p> <p>One exceedance of Total Fluoride concentration limit of 5mg/m<sup>3</sup>:</p> <ul style="list-style-type: none"> <li>5.8 mg/m<sup>3</sup> at EPL Point 14 (Kiln 1).</li> </ul> <p>One exceedance of Total Particulate concentration limit of 20mg/m<sup>3</sup>:</p> <ul style="list-style-type: none"> <li>21 mg/m<sup>3</sup> at EPL Point 15 (Kiln 2).</li> </ul>	<p>The cause of the non-compliance is considered to be variability in process and annual stack testing results. As a comparison, the fluoride emission result for Kiln 2 (EPL Point 15) using the same source material was 2.9 mg/m<sup>3</sup></p>
Project Approval Condition 15	<p>There were 11 exceedances of the 24 hour PM PM<sub>10</sub> criterion (50 µg/m<sup>3</sup>) at the NW monitoring station.</p> <p>There were five exceedances of the 24 PM<sub>10</sub> criterion (50 µg/m<sup>3</sup>) at the SE monitoring station.</p>	<p>DPIE were notified of the non-compliances upon receipt of the laboratory analytical results.</p> <p>A review of the exceedances and external contributing factors to these exceedances is undertaken in <b>Section 4.1.1</b>.</p> <p>NCIA were found to not be the main contributing factor in each of these exceedances.</p>

### 6.2 Audit Recommendations and Action Plan

In 2018, an Independent Environmental Compliance Audit of the NCIA facility was undertaken by Jacobs (Final Report dated 31 January 2019). The audit found that NCIA is generally in compliance with the conditions of its regulatory documents. A total of 159 compliance requirements were audited, of which 13 issues were identified as Not Compliant, 88 as Compliant and 58 as Not triggered.

The auditors made recommendations against each non-compliance, as well as recommendations where compliance was achieved but an improvement in performance could be made. A full summary of the non-compliances identified, recommendations made by the auditors, and the action taken by NCIA to address each of the recommendations is provided **Table 6-2**.

Table 6-2 Audit recommendations and NCIA action plan

#	Reference	Condition	Recommendation	Management Response	Status												
1	Project Approval 16 Load Limits	<p>Unless the OEH specifies otherwise, the Proponent shall ensure that the annual total load discharged from the site does not exceed the load limit specified for that pollutant in Table 3.</p> <table border="1"> <thead> <tr> <th>Assessable Pollutant</th> <th>Load limit (kg)</th> </tr> </thead> <tbody> <tr> <td>Coarse Particulates (Air)</td> <td>14338.00</td> </tr> <tr> <td>Fine Particulates (Air)</td> <td>26629.00</td> </tr> <tr> <td>Fluoride (Air)</td> <td>1850.00</td> </tr> <tr> <td>Nitrogen Oxides (Air)</td> <td>36828.00</td> </tr> <tr> <td>Sulfur Oxides (Air)</td> <td>36828.00</td> </tr> </tbody> </table>	Assessable Pollutant	Load limit (kg)	Coarse Particulates (Air)	14338.00	Fine Particulates (Air)	26629.00	Fluoride (Air)	1850.00	Nitrogen Oxides (Air)	36828.00	Sulfur Oxides (Air)	36828.00	NCIA to implement relevant measures to ensure compliance with the Project Approval load limits. NCIA to review and address stack concentrations that are above values used in the NCIA Expansion EIS (AECOM, 2010).	Management are committed to achieving compliance. Management acknowledge ongoing compliance issues with Fluoride concentration although the testing results raise questions. Management have committed to a complete refit of the baghouse at an estimated project cost of \$2.5m with a view to achieving short and long term compliance. Once compliance is demonstrated Management would like to seek discussions with the Department in regard to limits.	Capital works ongoing as at 27 October 2020 and progress reviewed/discussed with EPA as part of October 2020 site visit.
Assessable Pollutant	Load limit (kg)																
Coarse Particulates (Air)	14338.00																
Fine Particulates (Air)	26629.00																
Fluoride (Air)	1850.00																
Nitrogen Oxides (Air)	36828.00																
Sulfur Oxides (Air)	36828.00																
2	Project Approval Discharge limits and Stack Discharge Design Requirements 18	<p>Unless otherwise specified by the Director-General, the Proponent shall:</p> <p>a) comply with all monitoring (points) requirements and pollutant discharge concentrations as specified by the OEH in the EPL; and</p>	NCIA to review and address stack concentrations that are above values used in the NCIA Expansion EIS (AECOM, 2010) and this condition of the approval.	Management are committed to achieving compliance. Management acknowledge ongoing compliance issues with Fluoride concentration although the testing results raise questions. Management have committed to a complete refit of the baghouse at an estimated project cost of \$2.5m with a view to achieving short and long term compliance. Once compliance is demonstrated Management would like to seek discussions with the Department in regard to limits.	Capital works ongoing as at 27 October 2020 and progress reviewed/discussed with EPA as part of October 2020 site visit.												



#	Reference	Condition	Recommendation	Management Response	Status
3	Project Approval Discharge limits and Stack Discharge Design Requirements 18	b) ensure that the stack discharge design requirements comply with the EPL.	Refer to recommendation above for Condition 18 a).	Management are committed to achieving compliance. Management acknowledge ongoing compliance issues with Fluoride concentration although the testing results raise questions. Management have committed to a complete refit of the baghouse at an estimated project cost of \$2.5m with a view to achieving short and long term compliance. Once compliance is demonstrated Management would like to seek discussions with the Department in regard to limits.	Capital works ongoing as at 27 October 2020 and progress reviewed/discussed with EPA as part of October 2020 site visit.
4	Project Approval 32 Lighting	The Proponent shall ensure that the lighting associated with the project: a) complies with the latest version of Australian Standard <i>AS 4282(INT) - Control of Obtrusive Effects of Outdoor Lighting</i>	When the construction of the project extension commences carry out a review of the existing lighting on site to determine if it complies with the relevant standards and upgrade as required. All new lighting to comply with AS 4282.	On commencement of construction of the project extension management will ensure compliance with relevant standards. Management have no reason to believe that current lighting does not meet the relevant standards	Not applicable as condition not triggered

#	Reference	Condition	Recommendation	Management Response	Status
5	Project Approval Oversized Transportation 35	The Proponent shall obtain a permit for an oversized and over mass load from the RTA, if transportation of oversized or over mass materials or machinery is required for the project.	NCIA should attempt to locate the oversized transportation approval for the one oversized load received in 2018.	One oversize load which Management disclosed to the auditor that arrived during the period was coordinated by our customs broker, Tolsaf Cranes and Hogan's Heavy Haulage. RMS were contacted and approval gained to move the load including dates and times. Management could not source the documentation for the auditor from those coordinating the load. In future Management will appoint a project manager for such events to ensure appropriate records are maintained	Not applicable
6	Project Approval 38 Vehicle Queuing and Parking	The Proponent shall ensure that the parking dimensions, internal circulation, aisle widths, kerb splay corners, head clearance heights, ramp widths and grades of the car parking area in accordance with the current relevant Australian Standards <i>AS2890.1:2004</i> , except where amended by other conditions of this approval.	When the construction of the project extension commences car parking to be realigned to comply with AS2890. Any additional car parking will need to be in compliance with AS2890.	On commencement of construction of the project extension management will ensure compliance with relevant standards. There is enough space allocated, including marked spaces to comfortably accommodate all staff and visitors on site at all times. Management have no reason to believe that current car parking does not meet relevant standards.	Not applicable as condition not triggered

#	Reference	Condition	Recommendation	Management Response	Status
7	Project Approval 39 Vehicle Queuing and Parking	The Proponent shall ensure that disabled parking and assess is provided on-site and shall comply with Australian Standard <i>AS1428.1 (2001) - Design for Access and Mobility - Part 1 General Requirements for Access – Buildings</i> .	When the construction of the project extension commences car parking to be realigned to comply with AS2890. Any additional car parking will need to be in compliance with AS2890.	One disabled car part is provided and marked on site. This car park is adjacent to the showroom entry with a ramp provided. On commencement of construction of the project extension management will ensure compliance with relevant standards. Management have no reason to believe that current car parking does not meet relevant standards.	Not applicable as condition not triggered
8	Project Approval Environmental Reporting 59	Within 7 days of the detection of the incident, the Proponent shall provide the Director-General and any relevant agencies with a detailed report on the incident.	Continue to report incidents within the allocated timeframes.	Management will continue to report incidents as required under the project approval.	Ongoing
9	SoC Operation	Fluoride emissions would be managed within the kiln baghouses by implementing a mechanism where a fine spray of lime is injected into the kiln exhaust flow to scrub the HF emissions;	Implement the mechanism where a fine spray of lime is injected into the kiln exhaust flow to scrub the HF emissions.	Management have engaged POLEX Engineering to complete a full refit of the baghouse. The POLEX design includes mechanisms for a fine spray of lime to scrub the HF emissions	Capital works ongoing as at 27 October 2020 and progress reviewed/discussed with EPA as part of October site visit
10	IER 2015 Recommendation S3.28	3.28.1 NCIA should attempt to locate the Stage 1 Noise Validation Report.	NCIA should continue to attempt to locate the Stage 1 Noise Validation Report.	Management tried to source this as part of the 2015 audit.	Future compliance to be considered on triggering next stage

#	Reference	Condition	Recommendation	Management Response	Status
11	IER 2015 Recommendation S3.32	3.32.1 NCIA should either review the construction contract for the facility to assess if lighting was required to be installed in accordance with AS 4282:1997; or if this information is not available or is inconclusive, commission a qualified lighting expert to undertake a survey or audit of the outdoor lighting against AS 4282:1997 to verify its	No further recommendations provided. Refer to Project Approval 32 Lighting above.	No further comment	Refer to RAR # 4 in this document
12	IER 2015 Recommendation S3.38	3.38.1 To comply with this condition, NCIA must provide markings in accordance with Australian Standard AS2890.1:2004.	No further recommendations provided. Refer to Project Approval 38 above.	No further comment	Refer to RAR # 6 in this document
13	IER 2015 Recommendation S3.39	3.39.1 To comply with this condition, NCIA must provide markings in accordance with Australian Standard AS1428.1:2001.	No further recommendations provided. Refer to Project Approval 38 above.	No further comment	Refer to RAR # 7 in this document

## 7.0 Continuous Improvement Measures

Condition 60(j) of the Project Approval requires the AEMR to identify continuous improvement measures, outlining new developments in air quality and noise control, and detailing practices that have been implemented on site during the previous year to reduce air quality and noise impacts.

Emission concentrations of pollutants were generally in accordance with EPL and Project Approval limits throughout the 2019 - 2020 reporting period. There were 16 exceedances of the PM<sub>10</sub> 24 hour criterion however a review of processing and meteorological conditions on those days indicate that NCIA was not a major contributor to the exceedances.

Stack emissions testing identified one exceedance of the Total Fluoride discharge limit at emission source location Kiln 1 and one exceedance of Total Particulate at emission source location Kiln 2.

Noise monitoring results for the current reporting period indicated that noise emissions from NCIA were in compliance with the EPL and Project Approval noise criteria for all time periods, including the sleep disturbance criteria. A result within 2dB of the criteria was calculated at the Kenvil Place receiver for the daytime period with a 2dB exceedance considered negligible by the NPI.

Environmental improvement measures recently implemented by NCIA are summarised in the following sections.

### 7.1 General Environmental Management

General environmental management actions undertaken by NCIA are outlined in **Table 7-1**.

**Table 7-1 Timetable for environmental improvement actions**

Area of Concern	Identified Action	Completion Date
Solar Electricity	NCIA are currently installing a solar panel array that will generate 1MW of electricity during daylight hours. During operation all of this energy will be used by NCIA reducing electricity consumption by 10-15%. Feasibility works have been done on installing a further 2MW on the roof of the factory and ground mounted options are also being assessed.	Completed
Waste Heat Recovery	Through NCIA's manufacturing process a significant amount of hot air is exhausted into the atmosphere. NCIA are investigating piping the hot air currently exhausted through Hot Air Cooler 1 and 2 (HAC 1 and 2 / EPL 18 and EPL 19) back through insulated stainless-steel piping to the spray dryer. The spray dryer uses ambient air and a gas burner to dry water from a liquid slip into a powder which is then pressed to form the tiles. Once operational this is expected to reduce gas consumption by 10-15%.	Completed
New Kiln Baghouse	NCIA have engaged Porex Environmental Engineering Pty Ltd to completely refurbish the original kiln baghouse. This new purpose-built baghouse together with the expertise of Porex, and a continued focus on raw materials will ensure compliance with regulatory requirements.	Ongoing after Porex Engineering suffered financial difficulties and couldn't complete the project. NCIA have sourced other contractors to complete the project

Area of Concern	Identified Action	Completion Date
University of NSW	Raw materials and finished products are now sent to the University of NSW for testing on a routine basis. NCIA is leveraging off the University of NSW for assistance from time to time. Samples have previously been sent to Italy for testing but sending locally expedites the process and also generates local capacity building.	Completed
Hong Lu	Hong Lu joined the NCIA team in early 2018 with a focus on internal and external compliance. Hong Lu has a PHD in Materials Science and Engineering from the University of NSW. Whilst still developing in her role at NCIA, when settled it is hoped Hong Lu will provide benefits in the environmental and compliance space.	Completed
Gas Monitoring	A project has been undertaken to monitor gas consumption on individual pieces of equipment. Information is now available in real time. From this information NCIA has been able to focus on reducing consumption while maintaining production efficiency.	Completed
Camera's	16 Cameras have been installed in and outside the factory building. The cameras can be viewed live and record history. In the event of environmental issues, the camera history is available to be reviewed	Completed/Ongoing
Formalised daily conditions	Each afternoon a snapshot of the factory conditions are recorded and sent to senior management for review. These include the raw feed being processed, the glaze's being used and environmental checks.	Completed/Ongoing

## 7.2 Energy Efficiencies

As noted in previous AEMRs, a lot of NCIA's focus in recent times has been on achieving greater efficiencies. The objective is to achieve a greater tile production output for the same amount of power consumption and raw material input. For example, NCIA currently endeavours to improve the gas efficiency of the manufacturing process. **Figure 39** shows the evolution since 2011 of the amount of gas required (in gigajoules GJ) to produce one square metre of tiles, with data showing an overall improving trend in gas efficiency.

NCIA is currently in the process of reducing the size and weight of tiles with a view to reduce the amount of raw material inputs, energy and transport components whilst still achieving the same amount of saleable product output (m<sup>2</sup> of tiles).

NCIA has installed a Quality Assurance (QA) machine before the kiln on each of its production lines. This effectively reduces waste tiles going through the kiln and being fired, creating both a reduction in waste and a saving in energy consumption.

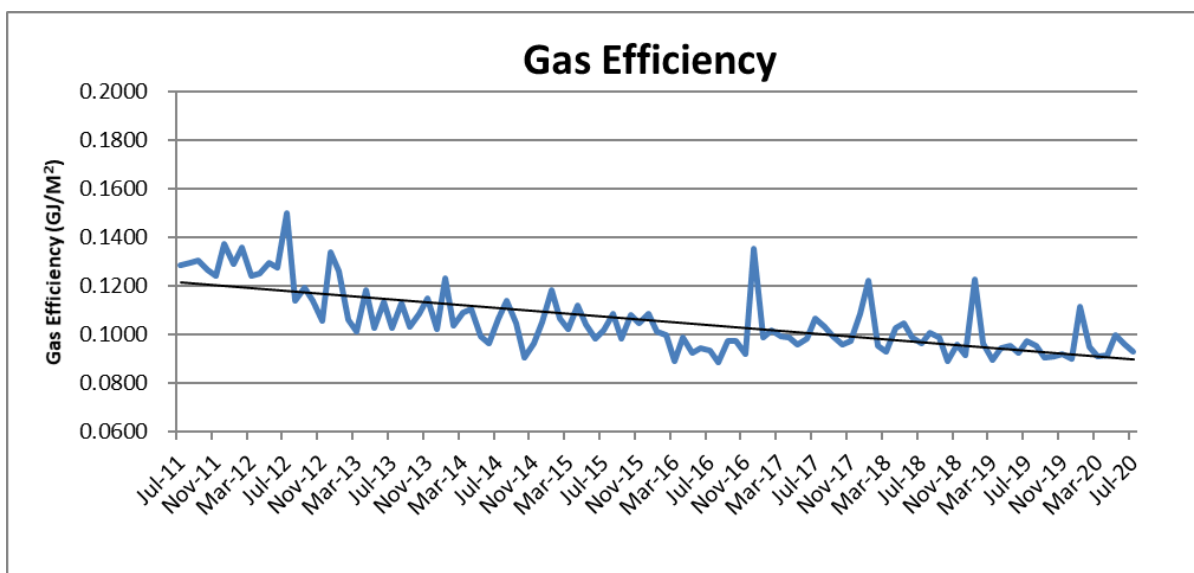


Figure 39 Gas efficiency in tile manufacturing process



## 8.0 References

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# Appendix A

## Fluoride Impact on Vegetation Data

## Appendix A1 – Vegetation Monitoring Sites

Area	Site #	Site location	Monitoring frequency	Location from the kiln stack
NCIA premises	1	Access road north of office	Annual	280m NW
	2	Office car park	Annual	120m W
	3	Access road south of office	Annual	160m W
	4	South-west corner of site	Annual	220m SW
	5	South-east corner of site	Quarterly	300m SE
Rutherford and Farley residential areas	6	3 Palisade Street	Annual	1.4km E
	7	3 Gillette Close	Quarterly	1.4km SE
	8	Regiment Road east of Dumont Court	Annual	1.5km SE
	9	Regiment Road south-east of Squadron Crescent	Annual	1.8kmSE
	10	Wollombi Road between sewage works and creek	Annual	2km SE
	11	Hill top on Wollombi Road, Farley	Quarterly	1.5km SE
	12	Western end of Quarry Road, Farley	Quarterly	2.3km S
Rutherford industrial estate	13	NCIA entrance, Racecourse Road	Quarterly	480m N
	14	99 Kyle Street	Quarterly	570m NW
	15	20 Gardiner Road	Quarterly	500m NW
	16	56 Gardiner Road	Annual	450m W
	17	Gardiner Road, southern end	Annual	550 SW
	18	Maitland Saleyards, Kyle Street	Quarterly	920m NW
Anambah homestead	19	200 Anambah Road – Reference site	Quarterly	3km N

**Site 1 – Access road north of office**



**Site 4 – South-west corner of site**



**Site 2 – Office car park**



**Site 5 – South-east corner of site**



**Site 3 – Access road south of office**



**Site 6 – 3 Palisade Street**





**Site 7 – 3 Gillette Close**



**Site 10 – Wollombi Road between sewage works and creek**



**Site 8 – Regiment Road east of Dumont Court**



**Site 11 – Hill top on Wollombi Road, Farley**



**Site 9 – Regiment Road south-east of Squadron Crescent**



**Site 12 – Western end of Quarry Road, Farley**





**Site 13 – NCIA entrance, Racecourse Road**



**Site 16 – 56 Gardiner Road**



**Site 14 – 99 Kyle Street**



**Site 17 – Gardiner Road, southern end**



**Site 15 – 20 Gardiner Road**



**Site 18 – Maitland Saleyards, Kyle Street**



**Site 19 – 200 Anambah Road (Reference site)**





**Appendix A2 – Visual Injury Expression Survey Results**

Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction # – buds or flowers	Reproduction # – fruits
<b>Site 1 – Access road north of office</b>															
<i>Acacia filicifolia</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	✓	0
<i>Olea europea</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia longifolia</i>	Q4 2019	0	1	1	0	0	0	0	0	1	0	0	0	0	0
<i>Corymbia citriodora</i>	Q4 2019	3	3	0	3	1	2	0	0	1	0	0	0	0	0
		5	5	1	5	3	3	0	0	1	2				
<i>Eucalyptus moluccana</i>	Q4 2019	1	1	0	0	1	0	0	0	1	0	0	0	0	✓
		1	1	1	0	1	1	0	0	1	1				
<i>Eucalyptus robusta</i> 1	Q4 2019	1	1	0	0	1	0	0	0	0	0	0	0	0	0
		2	2	1	2	2	1	0	0	1	1				
<i>Eucalyptus robusta</i> 2	Q4 2019	0	1	0	0	0	0	0	0	1	0	0	0	0	✓
		2	2	1	0	2	0	0	0	2	0				
<i>Eucalyptus amplifolia</i> (*new*)	Q4 2019	1	1	0	0	1	1	0	0	0	1	0	0	✓	0
		2	2	1	0	2	2	0	0	1	2				
<b>Site 2 – Office car park</b>															
<i>Corymbia maculata</i>	Q4 2019	0	0	<i>Specimen dead - removed from survey</i>											
		0	0												
<i>Eucalyptus robusta</i>	Q4 2019	1	1	0	1	0	0	0	0	1	1	0	0	0	✓
		3	3	1	3	0	2	0	0	0	2				
<i>Acacia longifolia</i> (*new*)	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Casuarina glauca</i> (*new*)	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Fraxinus pennsylvanica</i>	Q4 2019	n/a	n/a	<i>No new growth / foliage</i>								0	0	0	0
		0	0	0	0	0	0	0	0	0	0				
<b>Site 3 – Access road south of office</b>															
<i>Acacia parramattensis</i>	Q4 2019	0	2	1	0	0	0	0	0	2	0	0	0	✓	0
<i>Hakea salicifolia</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	✓
<i>Corymbia</i> (?) <i>citriodora</i>	Q4 2019	1	1	0	0	0	1	0	0	0	1	0	0	0	0
		3	3	1	0	3	2	0	0	0	1				
<i>Eucalyptus</i> sp.	Q4 2019	2	2	0	2	2	2	0	0	1	0	0	0	0	0
		3	3	1	2	3	2	1	0	2	1				
<b>Site 4 – South-west corner of site</b>															
<i>Acacia longifolia</i>	Q4 2019	0	2	1	0	0	0	0	0	2	0	0	0	0	0
<i>Bursaria spinosa</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	✓	0
<i>Typha</i> sp.	Q4 2019	2	2	0	0	2	0	0	0	0	0	0	0	0	✓



Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction # – buds or flowers	Reproduction # – fruits	
<i>Eucalyptus amplifolia</i>	Q4 2019	0	2	0	0	0	0	0	0	1	2	0	0	0	✓	
		2	2	1	0	2	1	0	0	1	2					
<b>Site 5 – South-east corner of site</b>																
<i>Eucalyptus moluccana</i>	Q3 2019	1	3	0	0	1	1	0	0	3	1	0	0	0	✓	
		2	3	1	0	1	2	0	0	3	2					
	Q4 2019	1	1	0	0	1	1	0	0	1	1	0	0	0	✓	
		2	2	1	0	2	2	0	0	1	2					
	Q1 2020	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
		2	3	1	0	2	0	0	0	3	1					
Q2 2020	1	3	0	0	1	0	0	0	0	3	1	0	0	0	0	
	3	3	1	0	2	0	0	0	3	2	1					
<i>Bursaria spinosa</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
<b>Site 6 – 3 Palisade Street</b>																
<i>Corymbia maculata</i> 1	Q4 2019	3	3	0	0	3	0	0	0	0	2	0	0	0	✓	
		3	3	1	0	3	3	0	0	0	3					
<i>Corymbia maculata</i> 2	Q4 2019	n/a	n/a	<i>Tree removed following site clearing in preparation of house building on block</i>												
		n/a	n/a													
<i>Olea europaea</i>	Q4 2019	1	1	1	0	1	0	0	0	0	0	0	0	0	0	
<b>Site 7 – 3 Gillette Close</b>																
<i>Eucalyptus acmenoides</i>	Q3 2019	1	1	0	1	0	1	0	0	0	1	0	0	✓	✓	
		2	2	1	2	0	2	0	0	1	2					
	Q4 2019	1	1	0	0	0	1	0	0	0	1	0	0	0	✓	
		3	3	1	3	1	2	0	0	1	2					
	Q1 2020	0	0	0	0	0	0	0	0	0	0	0	0	0	✓	
		2	2	1	1	1	0	2	0	0	1					
Q2 2020	2	2	0	2	0	0	0	0	0	2	1	0	0	✓	✓	
	2	2	1	1	1	2	0	0	0	2						
<i>Corymbia maculata</i>	Q3 2019	n/a	n/a	0	No new growth / foliage							0	0	0	0	
		3	3	1	0	3	2	2	0	1	2					
	Q4 2019	3	3	0	0	3	0	0	0	1	3	2	2	0	0	
		3	3	1	0	3	1	3	0	1	1					
	Q1 2020	3	3	0	0	0	3	0	0	0	0	2	2	0	0	
		3	3	1	1	2	3	1	2	1	2					
Q2 2020	n/a	n/a	0	No new growth / foliage							2	2	0	0		
	4	4	1	1	4	1	0	0	3	1						
<i>Acacia podalyriifolia</i>	Q4	2	2	0	2	0	0	1	0	0	0	0	0	0	0	

Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction # – buds or flowers	Reproduction # – fruits
	2019														
<i>Bursaria spinosa</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<b>Site 8 – Regiment Road east of Dumont Court</b>															
<i>Acacia baileyana</i>	Q4 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Corymbia maculata</i>	Q4 2019	3	3	0	0	3	0	0	0	1	3	0	0	0	0
		5	5	1	5	2	2	1	2	3					
<i>Bursaria spinosa</i>	Q4 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eucalyptus acmenoides</i>	Q4 2019	4	4	0	4	0	1	0	0	0	1	0	0	0	✓
		2	2	1	0	0	2	0	0	1	1				
<i>Lophostemon confertus</i>	Q4 2019	3	3	1	0	3	0	0	0	1	1	0	0	0	0
<i>Eucalyptus (?)paniculata</i>	Q4 2019	n/a	n/a	0	No new growth / foliage						0	0	✓	✓	
		2	2	1	0	1	2	0	1	1					1
<i>Grevillea robusta</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	2	2	0	✓
<b>Site 9 – Regiment Road south-east of Squadron Crescent</b>															
<i>Bursaria spinosa</i>	Q4 2019	n/a	n/a	Specimens cleared / removed											
<i>Eucalyptus resinifera</i>	Q4 2019	1	1	0	0	0	1	0	0	1	0	0	0	0	✓
		2	2	1	0	1	2	0	0	0	1				
<b>Site 10 – Wollombi Road between sewage works and creek</b>															
<i>Casuarina glauca</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Fraxinus excelsior</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	
<i>Grevillea robusta</i>	Q4 2019	1	1	1	0	0	1	0	0	0	0	0	0	0	
<i>Populus nigra</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	5	5	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia podalyriifolia</i>	Q4 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3	3	1	3	0	2	0	0	0	0				
<i>Bursaria spinosa</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	1	1	0	0
<b>Site 11 – Hill top on Wollombi Road, Farley</b>															
<i>Corymbia maculata</i>	Q3 2019	1	1	0	0	0	1	0	0	1	1	0	0	0	0
		2	2	1	0	1	2	0	0	1	1				
	Q4 2019	0	1	0	0	0	0	0	0	1	0	0	0	0	0
		2	2	1	0	2	2	0	0	1	2				
	Q1 2020	1	2	0	0	1	0	0	0	2	0	0	0	0	0
		2	2	1	0	0	2	0	0	1	2				
Q2 2020	3	3	0	0	3	2	0	0	3	2	0	0	0	0	
	3	3	1	0	3	2	0	0	1	1					
<i>Eucalyptus</i>	Q3	0	2	0	0	0	0	0	0	2	1	0	0	0	✓

Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction # – buds or flowers	Reproduction # – fruits	
<i>paniculata</i>	2019	1	4	1	0	1	0	0	0	4	2					
	Q4 2019	0	2	0	0	0	0	0	0	2	0	0	0	0	✓	
		0	3	1	0	0	0	0	0	3	1					
	Q1 2020	0	1	0	0	0	0	0	0	0	1	1	0	0	0	✓
		2	2	1	0	0	2	0	0	2	1					
Q2 2020	1	3	0	0	0	1	0	0	0	3	1	0	0	✓	0	
	3	3	1	0	1	3	0	0	1	1						
<i>Bursaria spinosa</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	2	2	0	0	
<i>Hakea gibbosa</i>	Q4 2019	n/a	n/a	Specimens cleared / removed												
<b>Site 12 – Western end of Quarry Road, Farley</b>																
<i>Corymbia maculata</i>	Q3 2019	1	1	0	0	0	1	0	0	1	1	0	0	0	0	
		1	3	1	0	1	1	0	0	3	1					
	Q4 2019	0	2	0	0	0	0	0	0	0	2	2	0	0	0	0
		1	1	1	0	0	1	0	0	1	1					
	Q1 2020	1	3	0	0	1	0	0	0	0	3	0	0	0	0	0
		2	2	1	0	2	1	0	0	2	1					
Q2 2020	n/a	n/a	0	No new growth / foliage								0	0	0	0	
	2	3	1	0	2	1	0	0	3	2						
<i>Eucalyptus paniculata</i>	Q3 2019	1	1	0	0	0	1	0	0	1	1	0	0	✓	0	
		1	3	1	0	0	1	0	0	3	1					
	Q4 2019	0	1	0	0	0	0	0	0	0	1	1	0	0	0	✓
		1	2	1	0	1	1	0	0	2	2					
	Q1 2020	n/a	n/a	0	No new growth / foliage								0	0	0	✓
		0	3	1	0	0	0	0	0	3	1					
Q2 2020	1	3	0	0	1	0	0	0	0	0	3	0	0	0	✓	
	1	2	1	0	0	1	0	0	1	2						
<i>Pinus radiata</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
<b>Site 13 – NCIA entrance, Racecourse Road</b>																
<i>Corymbia maculate</i>	Q3 2019	2	2	0	1	2	1	0	0	1	1	2	2	0	0	
		2	2	1	2	2	2	0	0	1	2					
	Q4 2019	1	1	0	0	1	1	0	0	0	1	0	0	0	0	
		3	3	1	2	2	3	1	0	0	3					
	Q1 2020	0	1	0	0	0	0	0	0	0	1	0	3	3	0	0
		2	2	1	1	1	2	0	0	1	2					
Q2 2020	3	3	0	3	2	1	0	0	0	1	1	2	2	0	0	
	3	3	1	0	2	3	0	0	1	2						
<i>Eucalyptus amplifolia</i>	Q3	2	2	0	0	1	2	0	0	1	1	2	2	✓	0	

Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction # – buds or flowers	Reproduction # – fruits
	2019	2	2	1	0	1	2	0	0	1	1				
	Q4 2019	1	1	0	0	0	1	0	0	1	1	0	0	✓	0
	2019	2	2	1	0	1	2	0	0	2	1				
	Q1 2020	0	2	0	0	0	0	0	0	2	1	3	3	✓	0
	2020	1	2	1	0	0	1	0	0	2	1				
	Q2 2020	1	3	0	0	0	1	0	0	3	1	2	2	✓	0
	2020	2	3	1	0	2	2	0	0	3	2				
<i>Olea Europea</i>	Q4 2019	2	2	1	0	2	0	0	0	0	0	0	0	0	✓
<b>Site 14 – 99 Kyle Street</b>															
<i>Angophora floribunda</i>	Q3 2019	3	3	0	1	3	1	0	0	0	1	0	3	0	0
	2019	1	1	1	1	1	1	0	0	0	1				
	Q4 2019	1	1	0	0	0	1	0	0	0	1	0	0	✓	0
	2019	2	3	1	1	0	2	0	0	0	3				
	Q1 2020	2	2	0	2	2	1	0	0	0	0	3	3	0	✓
	2020	3	3	1	2	2	3	2	0	0	3				
	Q2 2020	n/a	n/a	0	No new growth / foliage						2	2	0	✓	
<i>Eucalyptus amplifolia</i>	Q3 2019	1	1	0	0	0	1	0	0	0	0	0	0	✓	0
	2019	1	1	1	0	0	1	1	0	0	1				
	Q4 2019	1	1	0	0	0	1	0	0	1	1	0	0	✓	0
	2019	2	2	1	0	1	2	0	0	1	1				
	Q1 2020	1	1	0	0	0	1	0	0	0	1	0	0	0	✓
	2020	3	3	1	0	2	3	0	0	0	2				
	Q2 2020	1	1	0	0	1	1	0	0	0	1	0	0	0	✓
2020	1	2	1	0	1	1	0	1	1	2					
<b>Site 15 – 20 Gardiner Road</b>															
<i>Corymbia maculata</i>	Q3 2019	3	3	0	3	3	1	0	0	1	1	0	0	0	0
	2019	3	3	1	2	3	2	2	0	1	1				
	Q4 2019	4	4	0	3	4	3	0	0	1	1	0	0	0	0
	2019	4	4	1	4	4	3	0	0	1	1				
	Q1 2020	3	3	0	3	2	1	0	0	1	0	2	2	2	0
	2020	3	3	1	2	2	3	3	0	0	1				
	Q2 2020	4	4	0	4	3	1	0	0	1	1	1	1	0	0
2020	4	4	1	1	2	4	3	0	1	1					
<i>Eucalyptus Fibrosa</i>	Q3 2019	1	2	0	0	0	1	0	0	2	1	0	0	✓	0
	2019	3	3	1	0	1	3	0	0	2	1				
	Q4 2019	0	1	0	0	0	0	0	0	0	1	0	0	0	✓
	2019	0	4	1	0	0	0	0	0	4	1				
	Q1 2020	1	1	0	0	0	1	0	0	1	0	0	0	✓	✓
	2020	3	3	1	0	0	3	0	0	1	1				
	Q2 2020	1	2	0	1	0	1	0	0	0	2	0	0	✓	✓

Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction # – buds or flowers	Reproduction # – fruits	
	2020	3	3	1	0	0	3	0	0	1	1					
<b>Site 16 - 56 Gardiner Road</b>																
<i>Corymbia maculata</i>	Q4 2019	3	3	0	0	2	3	0	0	0	0	0	0	0	✓	
		4	4	1	4	3	3	0	0	1	2					
<b>Site 17 – Gardiner Road, Southern end</b>																
<i>Bursaria spinosa</i>	Q4 2019	1	1	1	1	0	0	0	0	0	0	0	0	0	0	
<i>Olea europaea</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
<i>Corymbia maculata</i> 1	Q4 2019	3	3	0	0	3	1	1	0	1	1	1	1	0	0	
		4	4	1	3	4	3	3	0	3	2					
<i>Corymbia maculata</i> 2	Q4 2019	2	2	0	0	2	2	0	0	1	0	0	0	0	0	
		5	5	1	0	5	2	1	0	0	3					
<i>Eucalyptus fibrosa</i>	Q4 2019	1	1	0	0	1	0	0	0	1	0	0	0	✓	0	
		3	3	1	0	0	3	0	0	0	1					
<i>Eucalyptus punctata</i>	Q4 2019	n/a	n/a	0	No new growth / foliage						0	0	0	✓		
		1	1	1	0	0	1	0	0	0					1	
<b>Site 18 – Maitland Saleyards, Kyle Street</b>																
<i>Corymbia maculata</i>	Q3 2019	2	2	0	1	2	1	1	0	0	2	0	0	✓	0	
		3	3	1	0	1	3	2	0	0	1					
	Q4 2019	2	2	0	0	2	2	0	0	0	2	0	0	✓	0	
		4	4	1	1	4	3	1	0	0	2					
	Q1 2020	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
		4	4	1	0	1	4	1	0	1	1					
Q2 2020	1	2	0	0	1	0	0	0	0	2	1	0	0	0	0	
	2	2	1	0	2	2	0	0	0	2						
<i>Eucalyptus amplifolia</i>	Q3 2019	1	1	0	0	0	1	0	0	1	1	0	0	✓	0	
		1	2	1	0	1	1	0	0	2	1					
	Q4 2019	1	1	0	0	0	1	0	0	1	1	0	0	✓	0	
		1	1	1	0	0	1	0	0	1	1					
	Q1 2020	0	1	0	0	0	0	0	0	0	1	0	0	0	0	✓
		3	3	1	0	1	3	0	0	0	1	0				
Q2 2020	n/a	n/a	0	No new growth / foliage						0	0	0	✓			
	2	2	1	0	0	2	0	0	1					1		
<i>Eucalyptus moluccana</i>	Q3 2019	n/a	0	No new growth / foliage						0	0	0	0			
		3	3	1	0	0	1	0	3					1	1	
	Q4 2019	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
		2	2	1	0	2	2	1	0	1	1					
	Q1 2020	n/a	n/a	0	0	0	0	0	0	0	1	0	0	0	0	0
1		1	1	0	1	1	0	0	1	1						

Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction# – buds or flowers	Reproduction# – fruits	
	Q2 2020	1	1	0	0	0	1	0	0	0	0	0	0	0	0	
		2	2	1	0	0	2	0	0	2	1					
<i>Eucalyptus resinifera</i>	Q3 2019	2	2	0	0	2	1	0	0	2	1	0	0	✓	0	
		2	2	1	0	2	1	0	0	1	1					
	Q4 2019	0	1	0	0	0	0	0	0	1	1	0	0	✓	✓	
		2	2	1	0	1	2	0	0	1	1					
	Q1 2020	n/a	n/a	0	No new growth / foliage								0	0	0	✓
		2	2	1	0	1	2	0	0	1	0					
	Q2 2020	n/a	n/a	0	No new growth / foliage								0	0	0	✓
		2	2	1	0	1	2	0	0	1	0					
<b>Site 19 – 200 Anambah Road – Reference site</b>																
<i>Angophora costata</i>	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	✓	0	
<i>Araucaria cunninghamii</i>	Q3 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Q1 2020	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Q2 2020	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
<i>Brachychiton populneus</i>	Q4 2019	2	2	1	0	2	0	0	0	0	0	0	0	0	0	
<i>Casuarina torulosa</i>	Q3 2019	0	0	1	0	0	0	0	0	0	0	0	0	1	0	
	Q4 2019	0	0	mix	0	0	0	0	0	0	0	0	0	0	0	
	Q1 2020	0	0	1	0	0	0	0	0	0	0	0	0	✓	0	
	Q2 2020	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
<i>Corymbia citriodora</i>	Q4 2019	1	1	mix	0	0	1	0	0	1	0	0	0	0	0	
<i>Corymbia maculata</i>	Q3 2019	3	3	mix	0	3	1	0	0	1	1	0	0	0	0	
	Q4 2019	3	3	mix	0	3	1	0	0	0	1	0	0	0	0	
	Q1 2020	3	3	mix	0	3	1	0	0	1	1	0	0	0	0	
	Q2 2020	2	2	1	0	2	1	0	0	1	1	0	0	0	0	
<i>Ficus macrophylla</i>	Q3 2019	0	0	mix	0	0	0	0	0	0	0	0	0	0	✓	
	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Q1 2020	0	0	1	0	0	0	0	0	0	0	0	0	0	✓	
	Q2 2020	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
<i>Grevillea robusta</i>	Q3 2019	1	1	mix	0	0	1	0	0	0	0	0	0	0	0	

Site/Species	Assessment period	Emissions injury	Total injury	Foliar age years *	Chlorosis index	Cupping index	Tip Necrosis index	Marginal Necrosis index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction # – buds or flowers	Reproduction # – fruits	
	Q4 2019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Q1 2020	1	1	1	0	0	1	0	0	0	0	0	0	0	0	
	Q2 2020	1	1	1	0	0	1	0	0	0	0	0	0	0	0	
<i>Macadamia integrifolia</i>	Q4 2019	2	2	1	0	2	0	0	0	0	0	0	0	0	✓	
<i>Eucalyptus acmenoides</i>	Q3 2019	0	1	mix	0	0	0	0	0	1	1	0	0	✓	✓	
	Q4 2019	1	1	mix	0	0	1	0	0	1	1	0	0	0	✓	
	Q1 2020	3	3	mix	0	0	3	0	0	1	0	0	0	0	0	
	Q2 2020	1	2	1	0	1	1	0	0	2	1	0	0	✓	✓	
<i>Eucalyptus dives</i>	Q4 2019	2	2	mix	0	1	2	0	0	1	1	0	0	0	✓	
<i>Eucalyptus grandis</i>	Q4 2019	1	1	mix	0	1	1	0	0	1	1	0	0	0	✓	
<i>Eucalyptus robusta</i>	Q4 2019	1	1	mix	0	1	1	0	0	1	1	0	0	0	✓	
<i>Eucalyptus tereticornis</i>	Q3 2019	3	3	mix	0	0	3	0	0	1	1	0	0	✓	0	
	Q4 2019	4	4	1	0	1	4	0	0	0	1	0	0	0	✓	
	Q1 2020	2	2	mix	0	1	2	0	0	1	2	0	0	0	✓	
	Q2 2020	2	2	1	0	0	2	0	0	2	1	0	0	0	0	
<i>Olea europaea</i>	Q3 2019	0	0	mix	0	0	0	0	0	0	0	0	0	0	0	
	Q4 2019	1	1	1	0	1	0	0	0	0	0	0	0	0	0	
	Q1 2020	1	1	1	0	1	0	0	0	0	0	0	0	0	0	
	Q2 2020	1	1	1	0	1	0	0	0	0	0	0	0	0	✓	
<i>Vitis vinifera</i>	Q3 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Q4 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	✓	
	Q1 2020	n/a	n/a	0	Vines recently sprayed and fully defoliated. No sampling undertaken											
	Q2 2020	n/a	n/a	0	Winter - deciduous species - no leaves											
<i>Vitis Vinifera - lower block</i>	Q4 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	✓	
<i>Vitis Vinifera - upper block</i>	Q4 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	✓	

Table key:




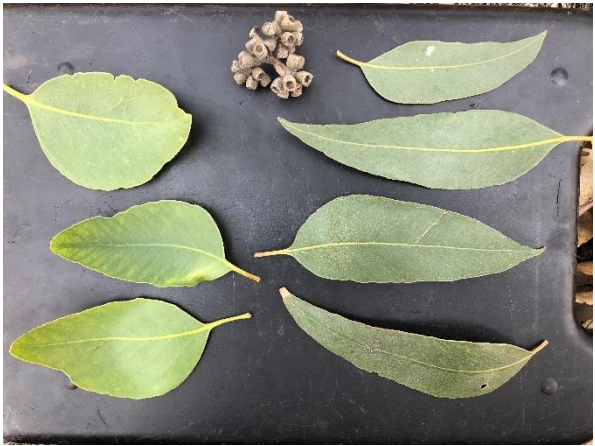

\* 'new' = assessment undertaken on current season leaves, 'old' = assessment undertaken on previous seasons leaves, 'mix' = assessment undertaken on both current and previous season leaves.

# For the assessment of reproductive strictures, '✓' means presence and 'x' means absence







- Indicates no visual assessment was undertaken due to the absence of foliage.









**Appendix A3 – Foliage Condition Photographs**

Site 1 – Access road north of office	
<b><i>Eucalyptus robusta</i> 1 (Q4 2018)</b>	<b><i>Eucalyptus robusta</i> 2 (Q4 2018)</b>
	
<b><i>Corymbia citriodora</i> (Q4 2018)</b>	<b><i>Eucalyptus moluccana</i> (Q4 2018)</b>
	
Site 2 – Office car park	
<b><i>Corymbia maculata</i> (Q4 2018)</b>	<b><i>Eucalyptus robusta</i> (Q4 2018)</b>
Specimen Dead – Removed from survey	



Site 3 – Access road south of office	
<b><i>Hakea salicifolia</i> (Q4 2018)</b>	<b><i>Eucalyptus</i> sp. (Q4 2018)</b>
	
Site 4 – South-west corner of site	
<b><i>Acacia longifolia</i> (Q4 2018)</b>	<b><i>Eucalyptus amplifolia</i> (Q4 2018)</b>
	
Site 5 – South-west corner of site	
<b><i>Eucalyptus moluccana</i> (Q4 2018)</b>	<b><i>Bursaria spinosa</i> (Q4 2018)</b>
	



Site 6 – 3 Palisade Street	
<b><i>Corymbia maculata</i> 1 (Q4 2018)</b>	<b><i>Olea Europaea</i> (Q4 2018)</b>
	
Site 7 – 3 Gillette Close	
<b><i>Eucalyptus acmenoides</i> (Q4 2018)</b>	<b><i>Corymbia maculata</i> (Q4 2018)</b>
	
Site 8 – Regiment Road east of Dumont Court	
<b><i>Corymbia maculata</i> (Q4 2018)</b>	<b><i>Eucalyptus acmenoides</i> (Q4 2018)</b>
	








Site 8 – Regiment Road east of Dumont Court (continued)	
<b><i>Acacia baileyana</i> (Q4 2018)</b>	<b><i>Bursaria spinosa</i> (Q4 2018)</b>
	
Site 9 – Regiment Road south-east of Squadron Crescent	
<b><i>Eucalyptus resinifera</i> (Q4 2018)</b>	
	
Site 10 – Wollombi Road between sewage works and creek	
<b><i>Fraxinus excelsior</i> (Q4 2018)</b>	<b><i>Populus nigra</i> (Q4 2018)</b>
	









Site 11 – Hill top on Wollombi Road, Farley	
<b><i>Corymbia maculata</i> (Q4 2018)</b>	<b><i>Eucalyptus paniculata</i> (Q4 2018)</b>
Site 12 – Western end of Quarry Road, Farley	
<b><i>Corymbia maculata</i> (Q4 2018)</b>	<b><i>Eucalyptus paniculata</i> (Q1 2019)</b>
Site 13 – NCIA entrance, Racecourse Road	
<b><i>Corymbia maculata</i> (Q4 2018)</b>	<b><i>Eucalyptus amplifolia</i> (Q4 2018)</b>









Site 14 – 99 Kyle Street	
<b><i>Angophora floribunda</i> (Q4 2018)</b>	<b><i>Eucalyptus amplifolia</i> (Q4 2018)</b>
	
Site 15 – 20 Gardiner Road	
<b><i>Corymbia maculata</i> (Q4 2018)</b>	<b><i>Eucalyptus fibrosa</i> (Q1 2019)</b>
	
Site 16 - 56 Gardiner Road	
<b><i>Corymbia maculata</i> (Q4 2018)</b>	
	





Site 17 – Gardiner Road, Southern end	
<p><b><i>Corymbia maculata</i> 1 (Q4 2018)</b></p> 	<p><b><i>Corymbia maculata</i> 2 (Q4 2018)</b></p> 
<p><b><i>Eucalyptus fibrosa</i> (Q4 2018)</b></p> 	<p><b><i>Eucalyptus punctata</i> (Q4 2018)</b></p> 
Site 18 – Maitland Saleyards, Kyle Street	
<p><b><i>Corymbia maculata</i> (Q4 2018)</b></p> 	<p><b><i>Eucalyptus moluccana</i> (Q4 2018)</b></p> 



Site 18 – Maitland Saleyards, Kyle Street (continued)	
<p><i>Eucalyptus amplifolia</i> (Q4 2018)</p> 	<p><i>Eucalyptus resinifera</i> (Q4 2018)</p> 
Site 19 – 200 Anambah Road – Reference site	
<p><i>Eucalyptus dives</i> (Q4 2018)</p> 	<p><i>Corymbia maculata</i> (Q4 2018)</p> 
<p><i>Eucalyptus acmenoides</i> (Q4 2018)</p> 	<p><i>Eucalyptus robusta</i> (Q4 2018)</p> 



Site 19 – 200 Anambah Road – Reference site (continued)	
<i>Eucalyptus tereticoris</i> (Q4 2018)	<i>Vitis vinifera</i> (Q4 2018)
	

## [Appendix A4 – Analytical Laboratory Documentation](#)

## CERTIFICATE OF ANALYSIS

**Work Order** : **EN1906655**  
**Client** : **AECOM Australia Pty Ltd**  
**Contact** : **Matthieu Catteau**  
**Address** : **PO BOX 73 HUNTER REGION MC**  
**HRMC NSW NSW, AUSTRALIA 2310**  
**Telephone** : **----**  
**Project** : **60613063 Task 1.3**  
**Order number** : **60613063 1.3**  
**C-O-C number** : **----**  
**Sampler** : **Koru Environmental**  
**Site** : **----**  
**Quote number** : **EN/004/16**  
**No. of samples received** : **6**  
**No. of samples analysed** : **6**

**Page** : 1 of 4  
**Laboratory** : Environmental Division Newcastle  
**Contact** : Hayley Worthington  
**Address** : 5/585 Maitland Road Mayfield West NSW Australia 2304  
**Telephone** : +612 4014 2500  
**Date Samples Received** : 23-Sep-2019 13:05  
**Date Analysis Commenced** : 24-Sep-2019  
**Issue Date** : 30-Sep-2019 16:06



Accreditation No. 825  
 Accredited for compliance with  
 ISO/IEC 17025 - Testing

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This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

### *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
^ = This result is computed from individual analyte detections at or above the level of reporting  
ø = ALS is not NATA accredited for these tests.  
~ = Indicates an estimated value.



## Analytical Results

Sub-Matrix: VEGETATION (Matrix: BIOTA)				Client sample ID	E. Moluccana - Site 15	Grasses - Site 11	E. Amplifolia - Site 13	C. Maculata - Site 13	C. Maculata - Site 15
Client sampling date / time				23-Sep-2019 00:00	23-Sep-2019 00:00	23-Sep-2019 00:00	23-Sep-2019 00:00	23-Sep-2019 00:00	
Compound	CAS Number	LOR	Unit	EN1906655-001	EN1906655-002	EN1906655-003	EN1906655-004	EN1906655-005	
				Result	Result	Result	Result	Result	
<b>EK040V: Fluoride in Vegetation</b>									
Fluoride	16984-48-8	10.0	µg/g	23.2	<10.0	35.7	<10.0	37.4	



### Analytical Results

Sub-Matrix: <b>VEGETATION</b> (Matrix: <b>BIOTA</b> )				Client sample ID	Vitis vinifera - Site 19	----	----	----	----
Client sampling date / time				23-Sep-2019 00:00	----	----	----	----	
Compound	CAS Number	LOR	Unit	EN1906655-006	-----	-----	-----	-----	
				Result	----	----	----	----	
<b>EK040V: Fluoride in Vegetation</b>									
Fluoride	16984-48-8	10.0	µg/g	<10.0	----	----	----	----	

## CERTIFICATE OF ANALYSIS

**Work Order** : **EN1909019**  
**Client** : **AECOM Australia Pty Ltd**  
**Contact** : **Matthieu Catteau**  
**Address** : **17 WARABROOK BOULEVARDE**  
**WARABROOK NSW, AUSTRALIA 2304**  
  
**Telephone** : **----**  
**Project** : **60613063 Task 1.3**  
**Order number** : **606136063 task 1.3**  
**C-O-C number** : **----**  
**Sampler** : **Koru Environmental**  
**Site** : **----**  
**Quote number** : **EN/004/16**  
**No. of samples received** : **6**  
**No. of samples analysed** : **6**

**Page** : 1 of 4  
**Laboratory** : Environmental Division Newcastle  
**Contact** : Hayley Worthington  
**Address** : 5/585 Maitland Road Mayfield West NSW Australia 2304  
  
**Telephone** : +612 4014 2500  
**Date Samples Received** : 19-Dec-2019 12:05  
**Date Analysis Commenced** : 23-Dec-2019  
**Issue Date** : 30-Dec-2019 15:05



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- Analytical Results

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### *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics, Mayfield West, NSW



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
^ = This result is computed from individual analyte detections at or above the level of reporting  
ø = ALS is not NATA accredited for these tests.  
~ = Indicates an estimated value.





**Analytical Results**

Sub-Matrix: BIOTA  
 (Matrix: BIOTA)

Client sample ID

				<b>E. Moluccana - Site 5 Leaves</b>	<b>Grasses - Site 11 Grasses</b>	<b>E. Amplifolia - Site 13 Leaves</b>	<b>C. Maculata - Site 13 Leaves</b>	<b>C. Maculate - Site 15 Leaves</b>
<i>Client sampling date / time</i>				19-Dec-2019 00:00	18-Dec-2019 00:00	18-Dec-2019 00:00	18-Dec-2019 00:00	18-Dec-2019 00:00
<i>Compound</i>	<i>CAS Number</i>	<i>LOR</i>	<i>Unit</i>	<b>EN1909019-001</b>	<b>EN1909019-002</b>	<b>EN1909019-003</b>	<b>EN1909019-004</b>	<b>EN1909019-005</b>
				Result	Result	Result	Result	Result
<b>EK040V: Fluoride in Vegetation</b>								
<b>Fluoride</b>	16984-48-8	10.0	µg/g	<b>28.8</b>	<b>15.7</b>	<b>97.8</b>	<b>29.7</b>	<b>72.5</b>



### Analytical Results

Sub-Matrix: BIOTA (Matrix: BIOTA)			Client sample ID	Vitis vinifera - Site 19 Leaves	----	----	----	----
Client sampling date / time			19-Dec-2019 00:00	----	----	----	----	
Compound	CAS Number	LOR	Unit	EN1909019-006	-----	-----	-----	-----
				Result	---	---	---	---
<b>EK040V: Fluoride in Vegetation</b>								
Fluoride	16984-48-8	10.0	µg/g	<10.0	---	---	---	---

## CERTIFICATE OF ANALYSIS

**Work Order** : **EN2002089**  
**Client** : **AECOM Australia Pty Ltd**  
**Contact** : **Matthieu Catteau**  
**Address** : **17 WARABROOK BOULEVARDE**  
**WARABROOK NSW, AUSTRALIA 2304**  
  
**Telephone** : **----**  
**Project** : **60613063 Task 1.3**  
**Order number** : **60613063 1.3**  
**C-O-C number** : **----**  
**Sampler** : **Koru Environmental**  
**Site** : **----**  
**Quote number** : **EN/004/16**  
**No. of samples received** : **5**  
**No. of samples analysed** : **5**

**Page** : 1 of 2  
**Laboratory** : Environmental Division Newcastle  
**Contact** : Tahlee Brook  
**Address** : 5/585 Maitland Road Mayfield West NSW Australia 2304  
  
**Telephone** : +61 2 4014 2500  
**Date Samples Received** : 30-Mar-2020 12:05  
**Date Analysis Commenced** : 02-Apr-2020  
**Issue Date** : 07-Apr-2020 14:54



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<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Joel Mullarvey	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW



## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
 LOR = Limit of reporting  
 ^ = This result is computed from individual analyte detections at or above the level of reporting  
 ø = ALS is not NATA accredited for these tests.  
 ~ = Indicates an estimated value.

## Analytical Results

Sub-Matrix: VEGETATION  
 (Matrix: BIOTA)

Client sample ID

				E. Moluccana - Site 5	Grasses - Site 11	E. Amplifolia - Site 13	C. Maculata - Site 13	C. Maculata - Site 15
Client sampling date / time				31-Mar-2020 00:00	31-Mar-2020 00:00	31-Mar-2020 00:00	31-Mar-2020 00:00	31-Mar-2020 00:00
Compound	CAS Number	LOR	Unit	EN2002089-001	EN2002089-002	EN2002089-003	EN2002089-004	EN2002089-005
				Result	Result	Result	Result	Result
<b>EK040V: Fluoride in Vegetation</b>								
Fluoride	16984-48-8	10.0	mg/kg	15.7	<10.0	22.4	<10.0	39.8

## CERTIFICATE OF ANALYSIS

**Work Order** : **EN2004457**  
**Client** : **AECOM Australia Pty Ltd**  
**Contact** : MS MAREE WELCH  
**Address** : 17 WARABROOK BOULEVARDE  
 WARABROOK NSW, AUSTRALIA 2304  
**Telephone** : +61 02 4911 4900  
**Project** : ----  
**Order number** : ----  
**C-O-C number** : ----  
**Sampler** : ----  
**Site** : ----  
**Quote number** : EN/004/16  
**No. of samples received** : 5  
**No. of samples analysed** : 5

**Page** : 1 of 2  
**Laboratory** : Environmental Division Newcastle  
**Contact** : Tahlee Brook  
**Address** : 5/585 Maitland Road Mayfield West NSW Australia 2304  
**Telephone** : +61 2 4014 2500  
**Date Samples Received** : 30-Jun-2020 13:15  
**Date Analysis Commenced** : 02-Jul-2020  
**Issue Date** : 08-Jul-2020 14:57



Accreditation No. 825  
 Accredited for compliance with  
 ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

### Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Joel Mullarvey	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW



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## Analytical Results

Sub-Matrix: VEGETATION  
 (Matrix: BIOTA)

Client sample ID

				E. Moluccana - Site 5	Grasses - Site 11	E. Amplifolia - Site 13	C. Maculata - Site 13	C. Maculata - Site 15
Client sampling date / time				30-Jun-2020 00:00	30-Jun-2020 00:00	30-Jun-2020 00:00	30-Jun-2020 00:00	30-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EN2004457-001	EN2004457-002	EN2004457-003	EN2004457-004	EN2004457-005
				Result	Result	Result	Result	Result
<b>EK040V: Fluoride in Vegetation</b>								
Fluoride	16984-48-8	10.0	µg/g	25.8	11.1	90.9	18.4	23.3

# Appendix B

## Meteorological Monitoring - Wind Roses

## Appendix B Meteorological Monitoring - Wind Roses



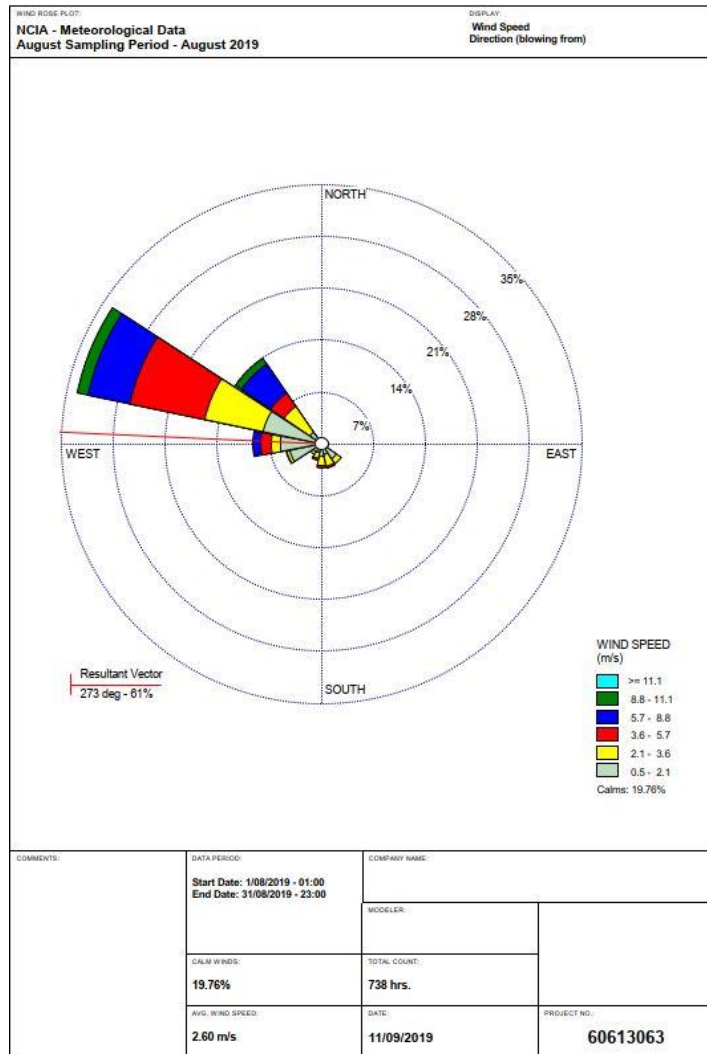


Figure B 1 Wind Speed and Direction (August 2019)

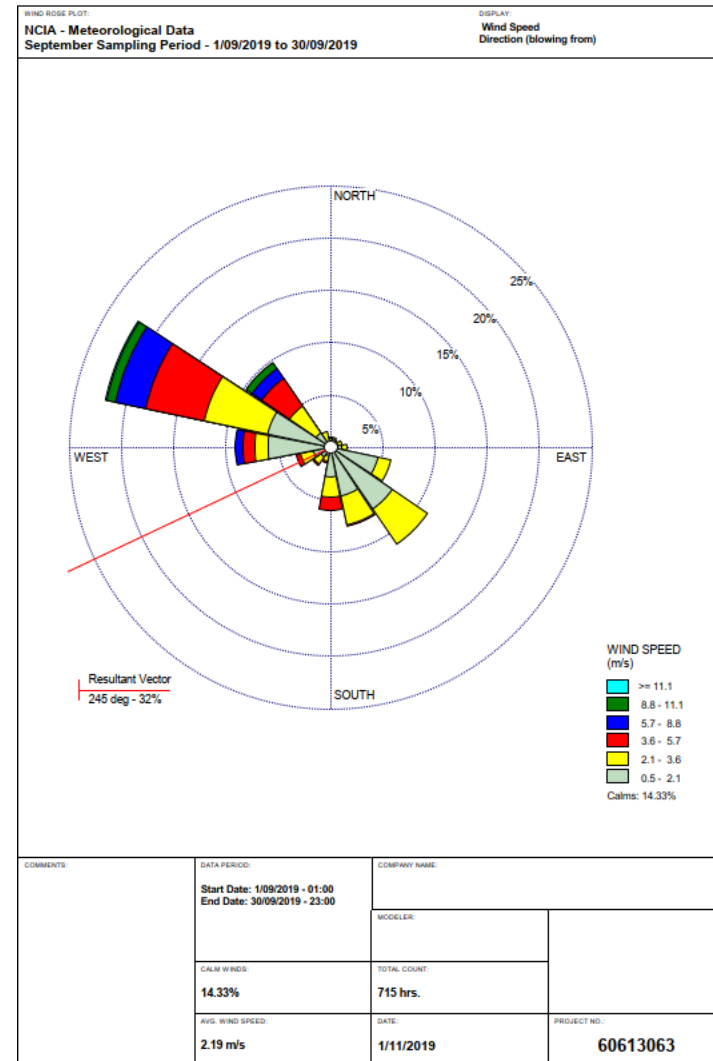


Figure B 2 Wind Speed and Direction (September 2019)

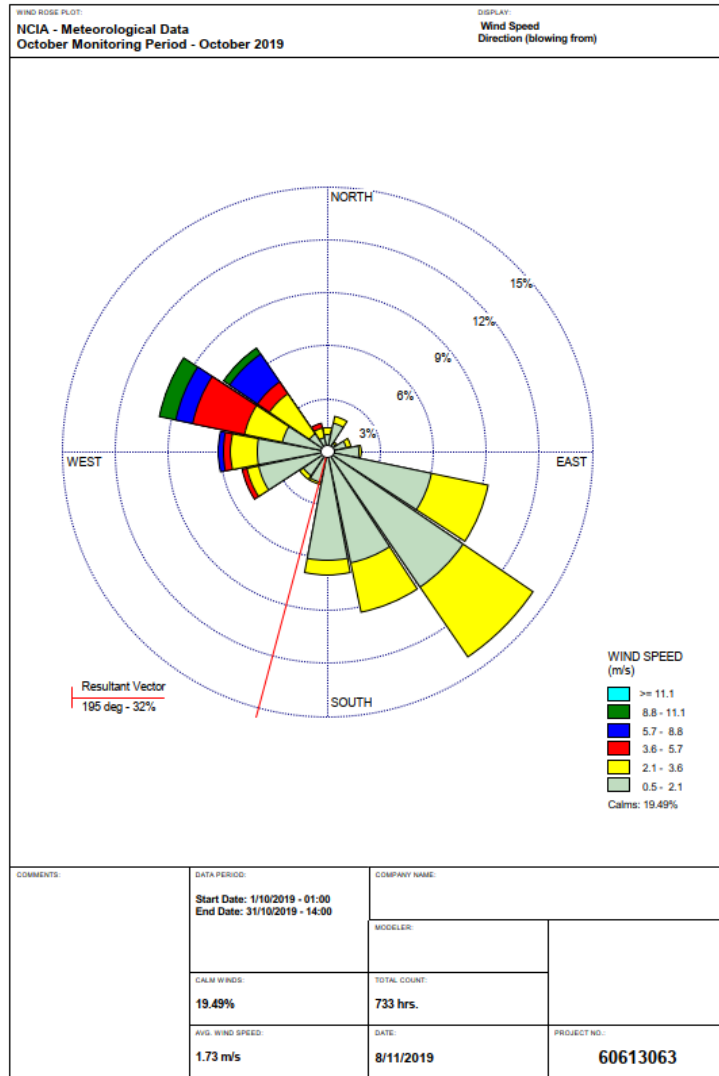


Figure B 3 Wind Speed and Direction (October 2019)

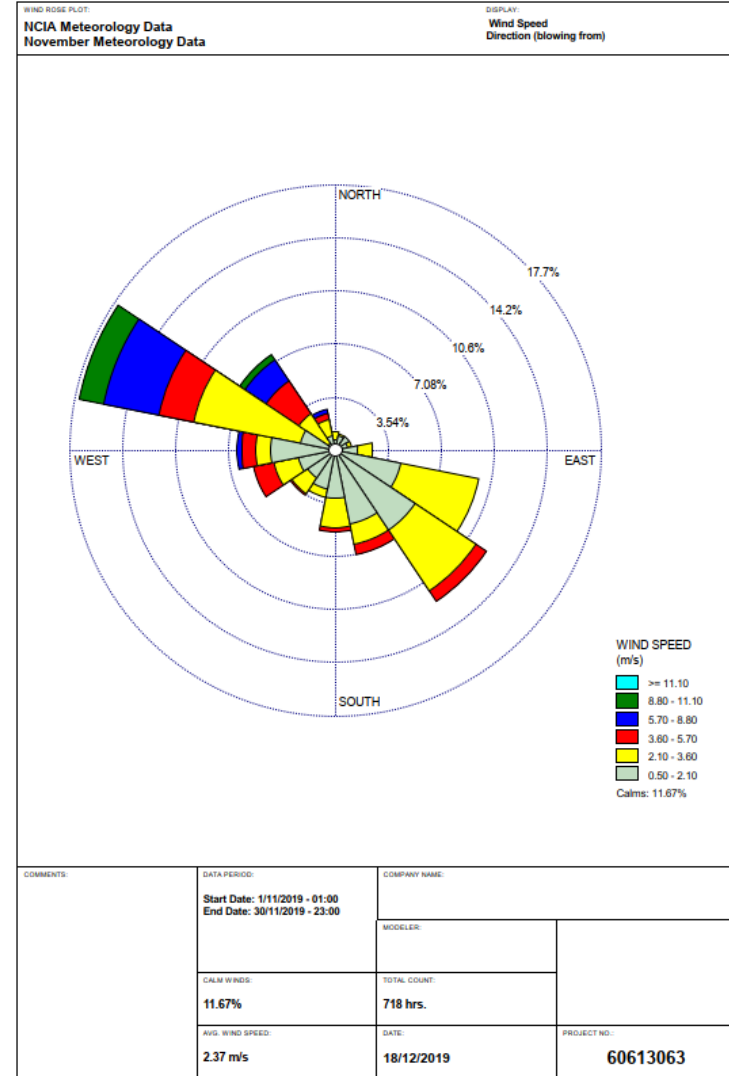


Figure B 4 Wind Speed and Direction (November 2019)

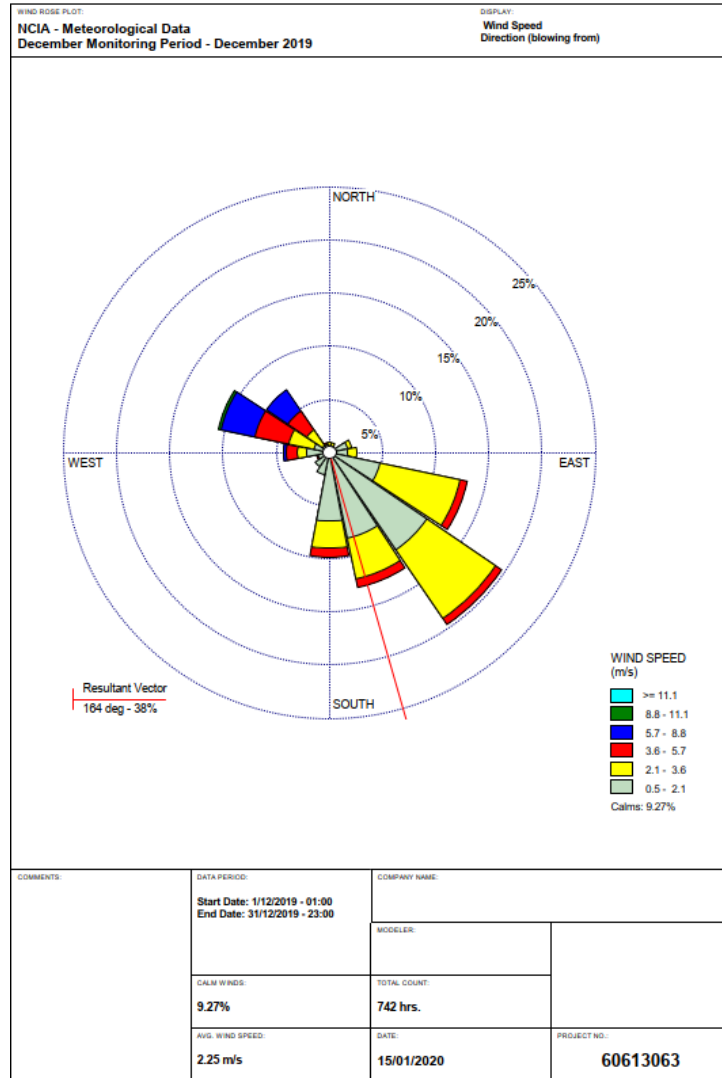


Figure B 5 Wind Speed and Direction (December 2019)

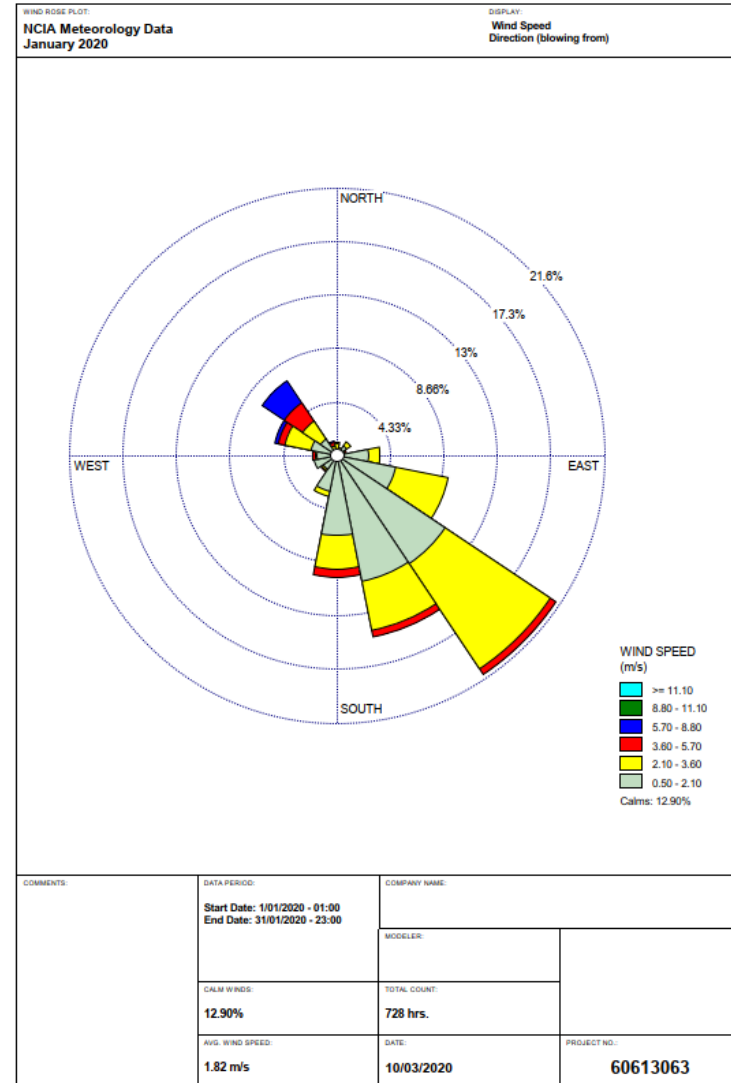


Figure B 6 Wind Speed and Direction (January 2020)

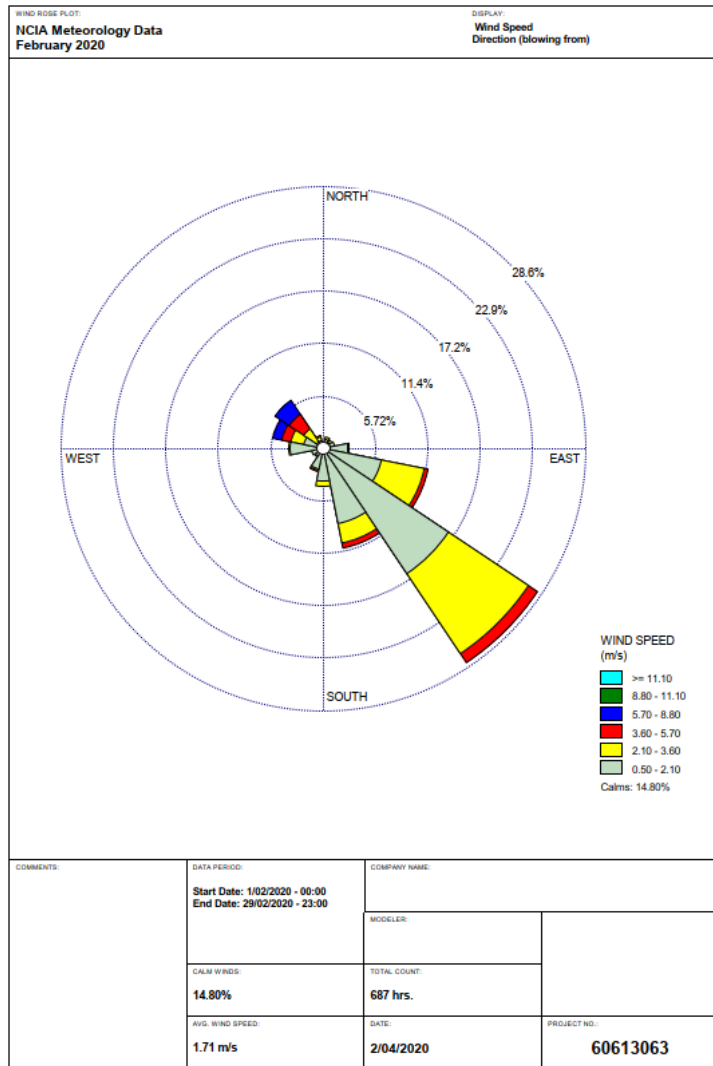


Figure B 7 Wind Speed and Direction (February 2020)

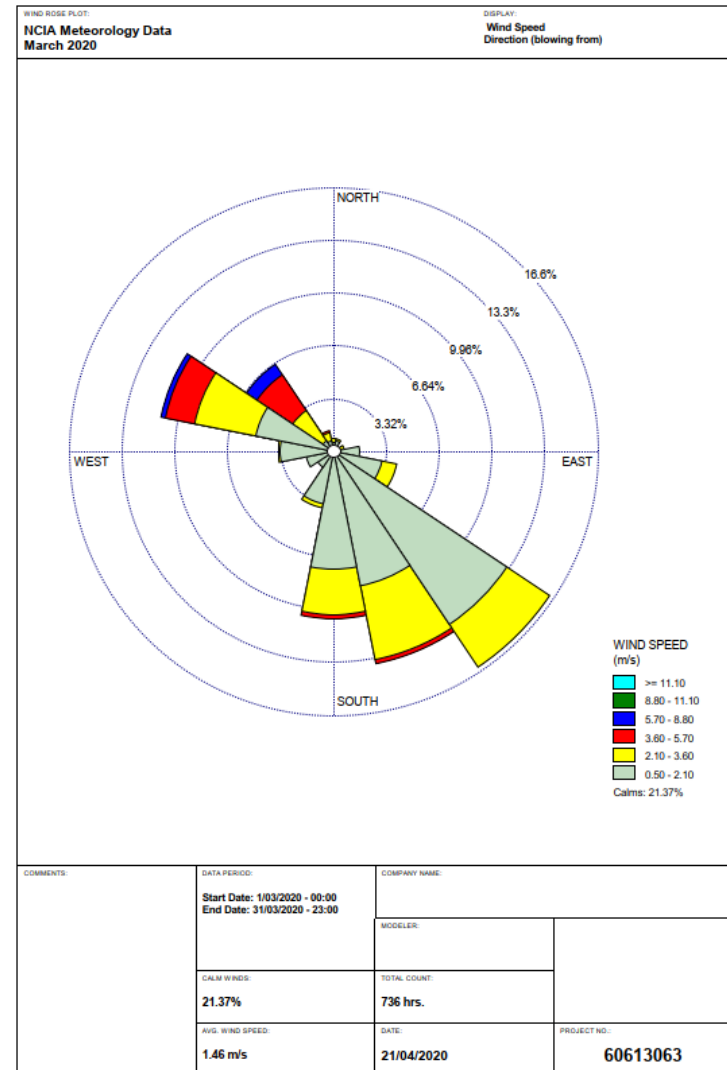


Figure B 8 Wind Speed and Direction (March 2020)

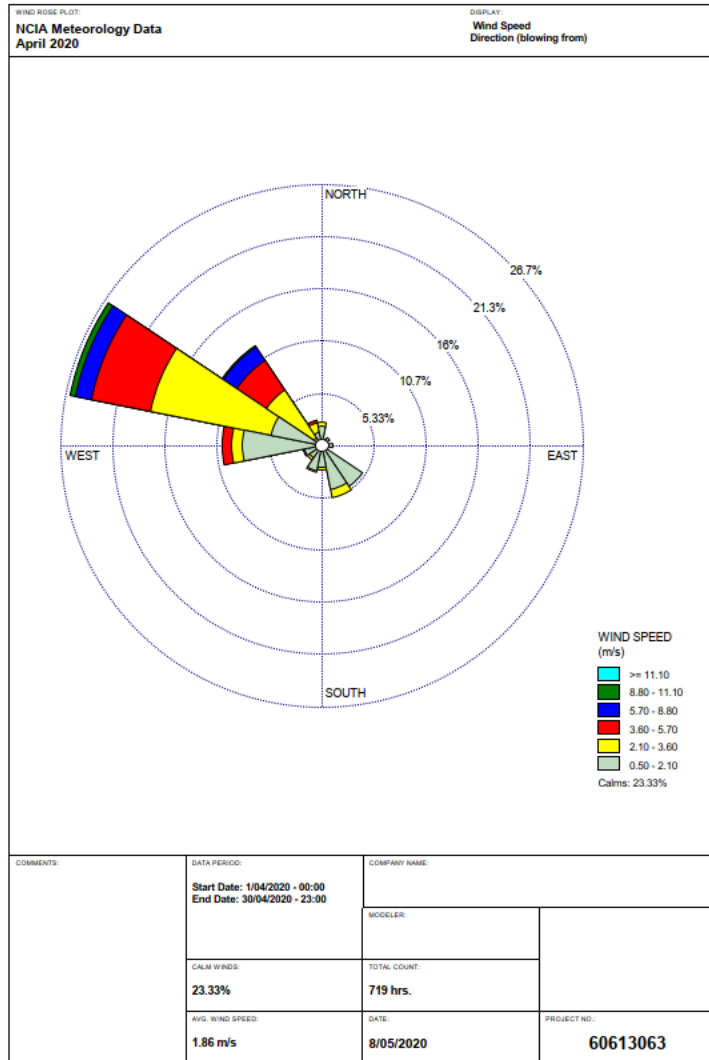


Figure B 9 Wind Speed and Direction (April 2020)

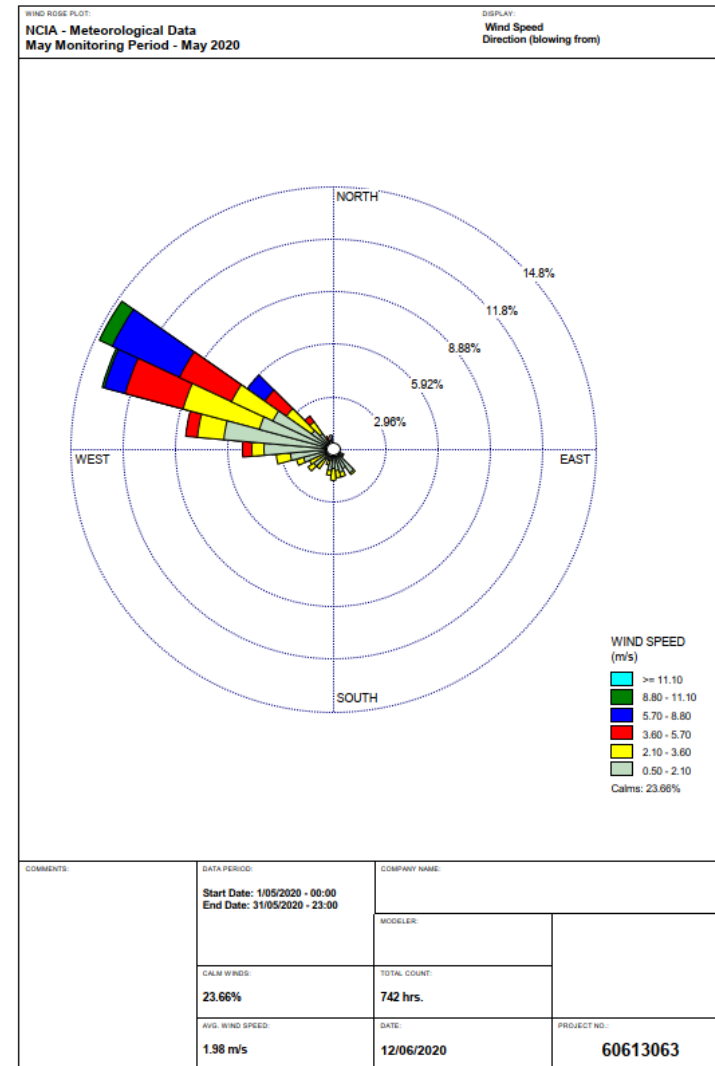


Figure B 10 Wind Speed and Direction (May 2020)

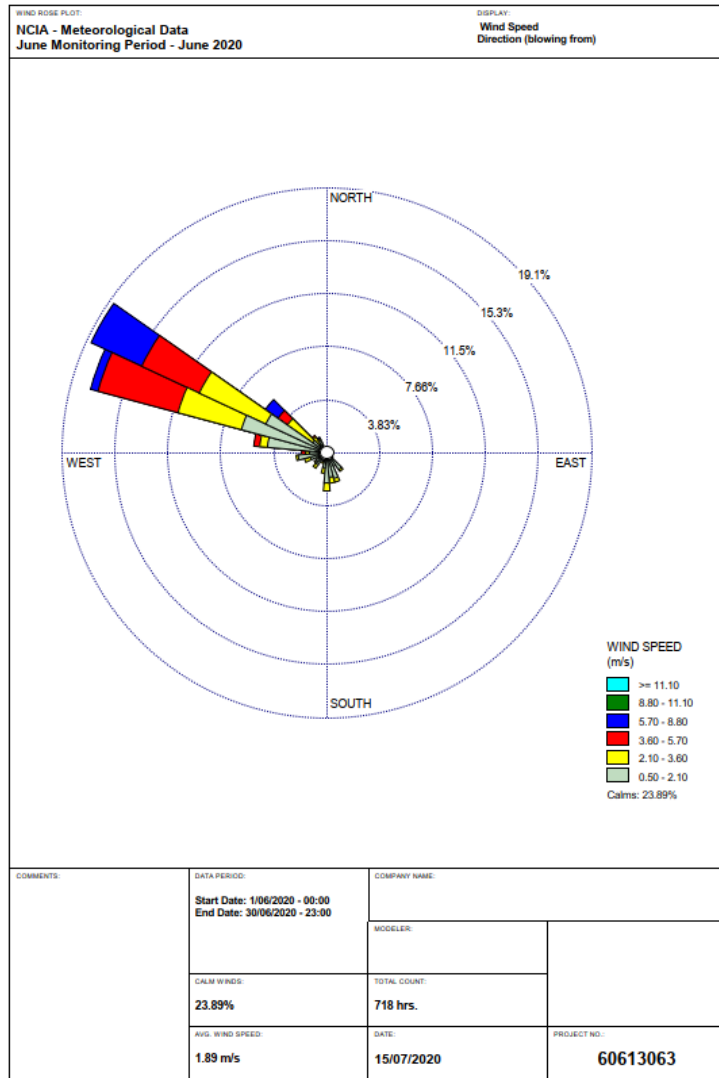


Figure B 11 Wind Speed and Direction (June 2020)

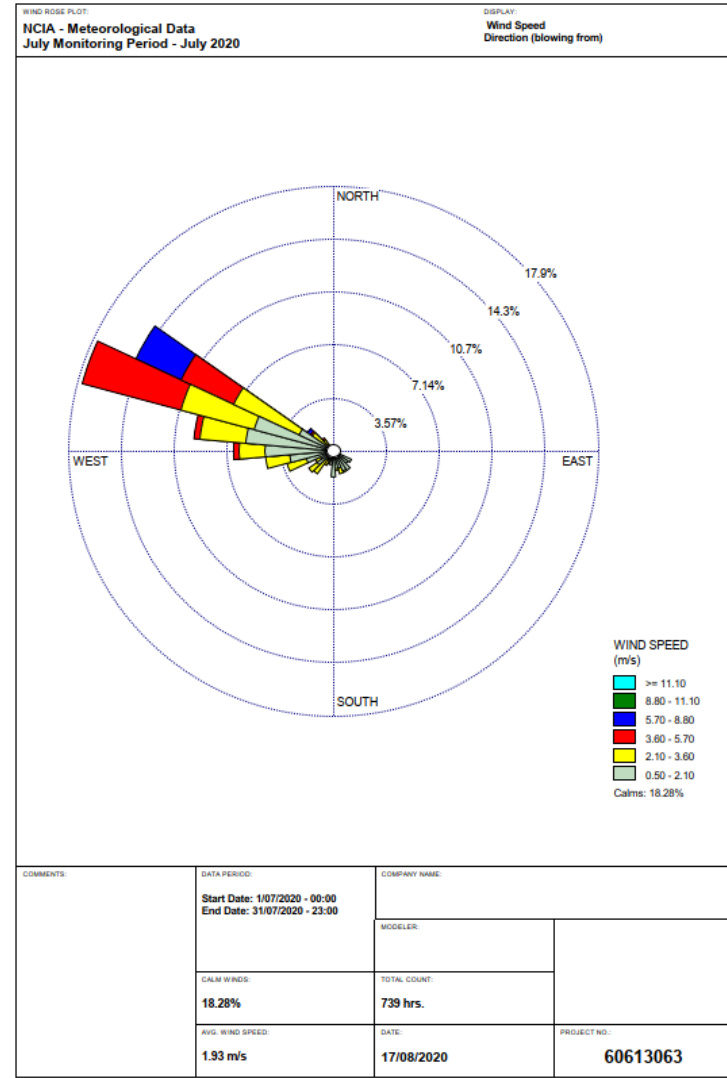


Figure B 12 Wind Speed and Direction (July 2020)

