National Ceramic Industries Australia
25 September 2012

2011 -2012 Annual Environmental Management Report

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2011 -2012 Annual Environmental Management Report

Prepared for

National Ceramic Industries Australia

Prepared by

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Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
	25-Sep-2012	Final	James McIntyre Principal Workgroup Leader - Singleton	

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1.0 Introduction

National Ceramic Industries Australia Pty Limited (NCIA), a tile manufacturing facility located in the Rutherford, New South Wales, is operated under the conditions of Development Consent DA 449-12-2002-i (the Development Consent), issued by the Department of Planning and Infrastructure (DP&I). This Annual Environmental Management Report (AEMR) has been prepared by AECOM Australia Pty Limited (AECOM) on behalf of NCIA in accordance with Schedule 2, Condition 8.4 of the Development Consent.

The AEMR outlines the environmental compliance and performance of the NCIA facility in relation to the conditions of the Development Consent and NCIA's Environment Protection Licence (EPL) No. 11956 (issued by the Office of Environment and Heritage (OEH)). The consent requirements are outlined in **Table 1**.

Table 1 Schedule 2 Condition 8.4 DA 449-12-2002-i

Condition No.	Condition	AEMR Section
8.4	The AEMR shall include, but not necessarily be limited to:	
8.4 a)	details of compliance with the conditions of this consent;	**Section 2** Appendix A
8.4 b)	a copy of the Complaints Register (refer to condition 6.3 of this consent) for the preceding twelve month period (exclusive of personal details), and details of how these complaints were addressed and resolved;	**Section 3**
8.4 c)	a comparison of the environmental impacts and performance of the ceramic tile manufacturing facility against the environmental impacts and performance predicted in the EIS and the additional information listed under condition 1.2;	**Section 5**
8.4 d)	results of all environmental monitoring required under this consent and other approvals, including interpretations and discussion by a suitably qualified person;	**Section 4**
8.4 e)	a list of all occasions in the preceding twelve-month period when environmental performance goals for the ceramic tile manufacturing facility have not been achieved, indicating the reason for failure to meet the goals and the action taken to prevent recurrence of that type of incident;	**Section 5 Appendix A Appendix B**
8.4 f)	identification of trends in monitoring data over the life of the ceramic tile manufacturing facility to date;	**Section 5**
8.4 g)	a list of variations obtained to approvals applicable to the ceramic tile manufacturing facility and to the site during the preceding twelve-month period; and;	**Section 6**
8.4 h)	environmental management targets and strategies for the following twelve-month period, taking into account identified trends in monitoring results.	**Section 7**

The AEMR is distributed to the following:

- the DP&I;
- the OEH; and.
- Maitland City Council.

The reporting period for the AEMR extends from 1 August 2011 to 31 July 2012.

1.1 Overview of Operations

NCIA manufactures ceramic wall and floor tiles for the Australian market from a mixture of clay, white granite, rhyolite, and glazes. The facility is located off Racecourse Road, Rutherford, within the Rutherford Industrial Estate. The operation currently comprises one spray drier, a clay mill, two tile production lines and two kilns, representing the first two of four approved operational stages. The facility operates 24 hours per day, 7 days per week, and 330 days over the reporting period.

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2.0 Compliance Review

A detailed assessment of the compliance of the facility in relation to the conditions of the Development Consent and the EPL is provided in **Appendix A**.

Details of non-compliances of the facility against the conditions of the EPL were provided to the OEH in the Annual Return submitted for the reporting period. The Annual Return is provided in **Appendix B**.

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3.0 Complaints

Over the reporting period, no complaints were received. As such it is not necessary to supply a copy of the Complaint Register.

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4.0 Environmental Monitoring Results

The following parameters are monitored for the facility in accordance with the conditions of the Development Consent and / or the EPL and / or for internal due diligence requirements:

- Ambient air monitoring (northwest and southeast of the facility):
  - PM_{10}; 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 (TSP); and
  - Fine particulates (PM_{10}).
- Additionally, for the kiln stack:
  - Mercury (Hg);
  - Cadmium (Cd);
  - Nitrogen Oxides(NO_x);
  - Hazardous substances (metals);
  - Hydrogen Fluoride (HF);
  - Sulfuric acid mist (H_2SO_4); and
  - Sulfur trioxide (SO_3).
- Noise testing:
  - $LA_{eq(15\ minute)}$; and
  - $LA_{1(1\ minute)}$.
- Due diligence Water Usage Measurements.

A discussion of the monitoring results for these parameters provided below, with data summaries and reports provided in **Appendices C – F**.

4.1 Ambient Air Monitoring

The ambient air quality monitoring program commenced on 12 March 2004 to gain background data prior to commencement of Stage 1 operations on 15 April 2004. The program has continued throughout the development of NCIA operations.

The ambient air quality monitoring approach described herein was designed and implemented in accordance with the requirements of NCIA's Development Consent and EPL and is described in NCIA's *Proposed Air Quality Monitoring Program*, ENSR (2004). The air quality monitoring program involves monitoring of PM_{10}, hydrogen fluoride, meteorological conditions and flora surveys designed to assess the effects of fluoride emission on vegetation.

Under Condition 5.2 of the Development Consent, ambient monitoring is required to "be conducted for the nearest sensitive receptors or specialised land use". **Figure 1** identifies ambient air monitoring site locations.

For PM_{10} monitoring, two sampling locations were established to determine concentrations at the NCIA property boundary, along the dominant southeast-northwest wind axis. The monitors are sited in accordance with AS 2922 (1987). Sampling and analyses of PM_{10} are undertaken per AS 3580.9.6 (2003). Discrete 24-hour samples are collected every 6 days according to the NSW OEH schedule.

Two fluoride monitoring units (manual, double filter paper samplers) have been sited at each of the two locations identified for monitoring of PM_{10}, and are operated in accordance with AS3580.13.2 (1991). At each location, one monitor operates continuously over a 7-day period to provide weekly fluoride concentration averages. These units are designated 'Northwest HF_7' and 'Southeast HF_7'. The remaining unit at each site operates continuously for discrete 24-hour periods according to the NSW OEH 6-day cycle to provide 24-hour averages for sampler operation days. Units are designated 'Northwest HF' and 'Southeast HF'.

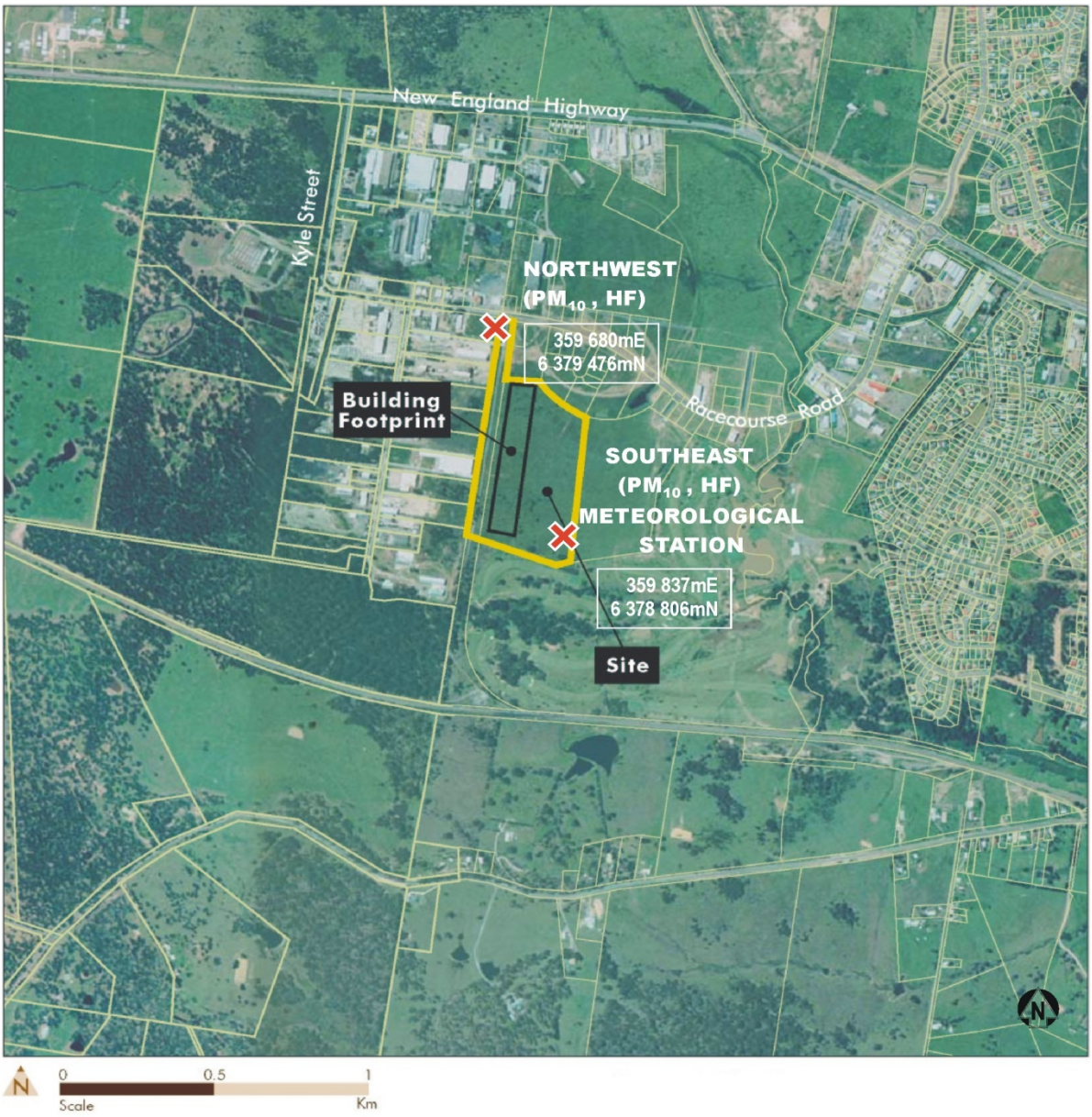

Figure 1 Ambient Air Monitoring Site Locations

4.1.1 Ambient Air Monitoring Results

In accordance with EPL condition M2.1, PM_{10} (24-hour) and Fluoride (24-hour and weekly) have been monitored at two locations; northwest and southeast of the facility.

There are no ambient air concentration limits required by the Consent or EPL. To provide context for the ambient air monitoring results, criteria have been taken from the OEH's *Approved Methods for Modelling and Assessment of Air Pollutants in NSW*.

A summary of the historical results (15 March 2004 – 31 July 2012) and results from the AEMR reporting period are provided below.

4.1.2 PM_{10} – Monitoring Results

4.1.2.1 NW Monitoring Location

A summary of the historical PM_{10} results (15 March 2004 – 31 July 2012) and results from the AEMR reporting period for the NW monitoring location are provided in **Table 2**, with PM_{10} results for the AEMR reporting period also graphed in **Figure 2**. Raw data is provided in **Appendix C**.

Table 2 Summary of Ambient Monitoring PM_{10} Results - NW Sampling Location

	PM_{10}		
Monitoring Period	**2004 - 12**	**2011 - 12**	**Criteria**
Average Concentration (µg/m^3)	29.0	24.6	30
Standard Deviation (µg/m^3)	18.8	10.3	-
Minimum Concentration (µg/m^3)	2.0	11.2	-
Maximum Concentration (µg/m^3)	174.0	71.9	50

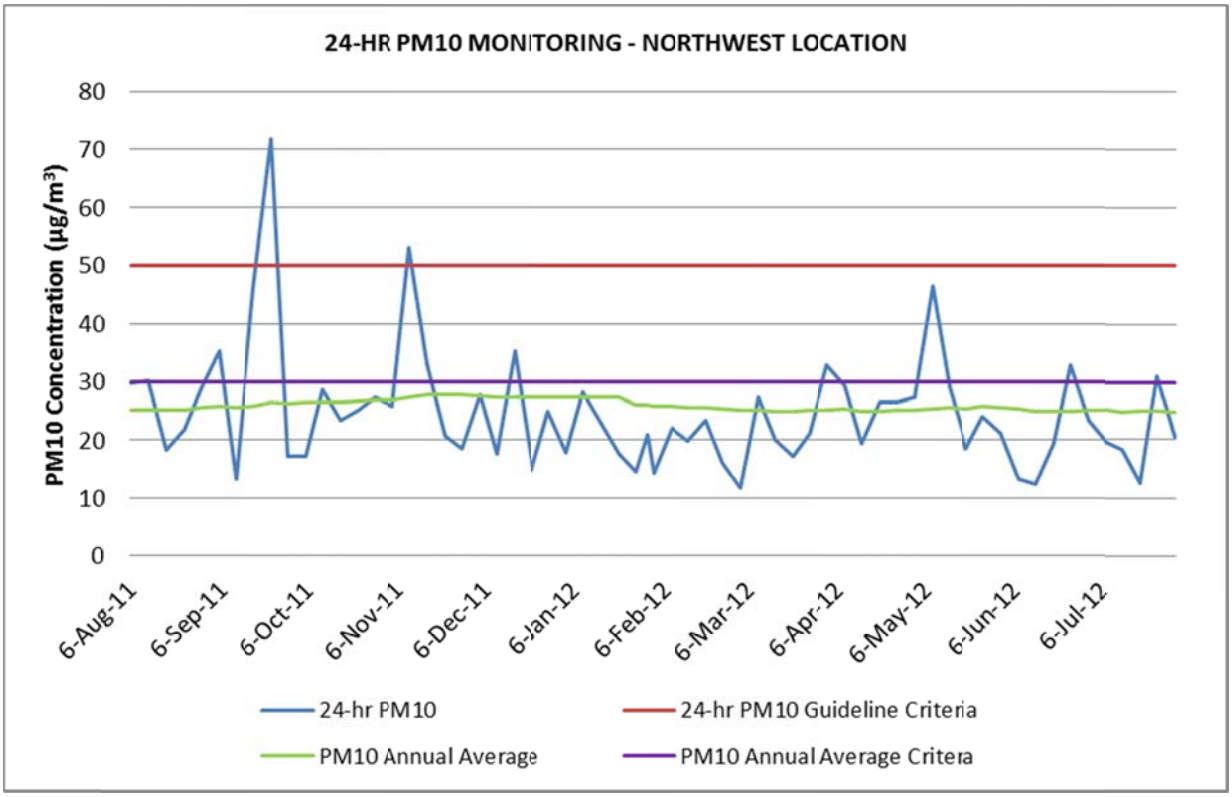

Figure 2 24 Hour PM_{10} Monitoring – Northwest Location

The PM_{10} results for the AEMR reporting period were variable at the NW monitoring location, with two exceedances of the 24 hour guideline criteria recorded, as follows:

- 23 September 2011 – 71.9µg/m^3; and
- 10 November 2011 – 53.1µg/m^3

The PM_{10} annual average level for the reporting period was below PM_{10} annual average criterion.

The wind rose for 23 September 2011 shows that the prevailing winds during this 24 hour period were from the west with some wind from the south east. Under these conditions, the north-west sampling location is primarily upwind of the NCIA facility, therefore it is unlikely that NCIA contributed solely to the elevated result at the north-west corner of the site on 23 September 2011.

Meteorology data recorded at the South East site shows that winds on the 10th of November were primarily from the West Southwest, indicating that it's unlikely that National Ceramics contributed to the exceedence. Wind speed on this day was relatively high (2.54m/s) and may have contributed to the result.

A comparison of the NW PM_{10} results gained since commencement of operations (15 March 2004 to 31 July 2012) against data for the AEMR reporting period reveals the following:

- The average concentration of PM_{10} at the NW monitoring location was lower than the long term average by 4.4 µg/m^3 (which equates to a decrease of approximately 15%).
- The PM_{10} results recorded at the NW sampling location ranged from 2.0 – 174 µg/m^3 (since commencement) and 11.2 – 71.9 µg/m^3 for the 2011 – 2012 reporting period.

4.1.2.2 SE Monitoring Location

A summary of the historical PM_{10} results (15 March 2004 – 31 July 2012) and results from the AEMR reporting period for the SE monitoring location are provided in **Table 3**, with PM_{10} results for the AEMR reporting period also graphed in **Figure 3**. Raw data is provided in **Appendix C**.

Table 3 Summary of Ambient Monitoring PM_{10} Results - SE Monitoring Location

	PM_{10}		
Monitoring Period	**2004 - 12**	**2011 - 12**	**Criteria**
Average Concentration (µg/m^3)	19.3	17.4	30
Standard Deviation (µg/m^3)	10.2	6.5	-
Minimum Concentration (µg/m^3)	1.0	6.4	-
Maximum Concentration (µg/m^3)	67.0	35.2	50

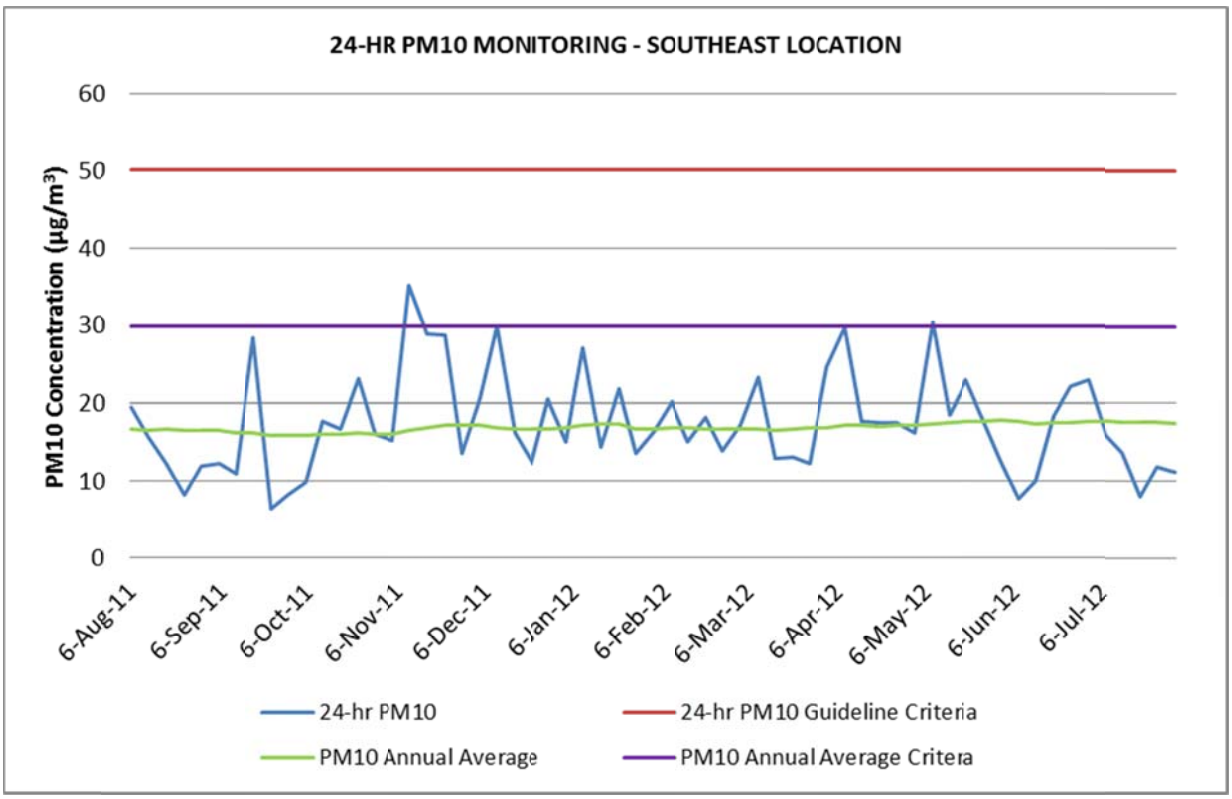

Figure 3 24 Hour PM_{10} Monitoring – Southeast Location

PM_{10} results for SE monitoring location for the AEMR monitoring period were below the PM_{10} 24 hour guideline criterion, and the PM_{10} annual average criterion for the entire reporting period.

A comparison of the SE PM_{10} results gained since commencement of operations (15 March 2004 to 31 July 2012) against data for the 2011 – 2012 reporting period reveals the following:

- The average concentration of PM_{10} at the SE monitoring location was lower than the long term average by 1.9 µg/m^3 (which equates to a decrease of approximately 10%).
- The PM_{10} results recorded at the SE sampling location ranged from 1.0 – 67 µg/m^3 (since commencement) and 6.4 – 35.2 µg/m^3 for the 2011 – 2012 reporting period.

4.1.3 Fluoride – 24 Hour Monitoring Results

4.1.3.1 NW Monitoring Location

A summary of the historical 24 hour Fluoride results (15 March 2004 – 31 July 2012) and results from the AEMR reporting period for the NW monitoring location are provided in **Table 4**. **Figure 4** graphs the results of the 24-hour Fluoride monitoring events during the AEMR reporting period. Raw data is provided in **Appendix C**.

Table 4 Summary of Ambient Monitoring Fluoride Results (24h) - NW Monitoring Location

	Fluoride – 24 h		
Monitoring Period	2004 - 12	2011 - 12	Criteria
Average Concentration (µg/m^3)	0.210	0.183	-
Standard Deviation (µg/m^3)	0.393	0.137	-
Minimum Concentration (µg/m^3)	0.004	0.051	-
Maximum Concentration (µg/m^3)	7.169	0.855	2.9

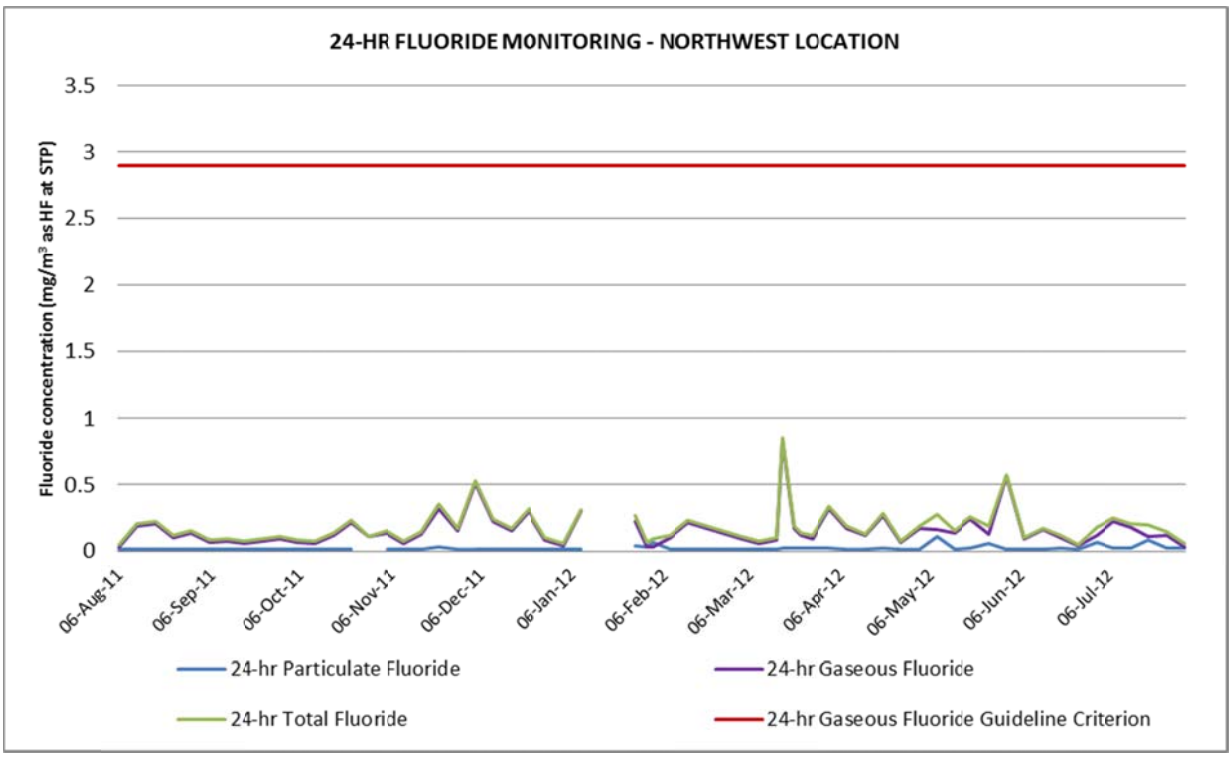

Figure 4 24-hour Fluoride Monitoring – Northwest Location

Fluoride concentrations for all 24 hour monitoring events at the NW monitoring location satisfied OEH criteria throughout the AEMR reporting period.

A comparison of the NW 24 hour Fluoride results obtained since commencement of operations (15 March 2004 to 31 July 2012) against data for the AEMR reporting period reveals the following:

- The average concentration of 24 hour Total Fluoride for the current year was lower than the long term average at NW sampling location (0.183 µg/m^3 compared to 0.210 µg/m^3).
- The 24 hour Total Fluoride results recorded at the NW sampling location ranged from 0.004 µg/m^3 – 7.169 µg/m^3 (since commencement) and 0.051 µg/m^3 – 0.855µg/m^3 (for the 2010 – 2011 reporting period).

As reported to the OEH as part of the Annual Return (refer to **Appendix B**), sampling of 24 hour fluoride was not undertaken on one occasion due to a power outage experienced that week which prevented sampling.

NCIA has updated its ambient sampling procedure to include a requirement for one make-up sample to be taken for each missed scheduled sample to ensure that the required number of samples are obtained over the course of future reporting periods.

4.1.3.2 SE Monitoring Location

A summary of the historical 24 hour Fluoride results (15 March 2004 – 31 July 2012) and results from the AEMR reporting period for the SE monitoring location are provided in **Table 5**. **Figure 5** graphs the results of the 24-hour Fluoride monitoring events during the AEMR reporting period. Raw data is provided in **Appendix C**.

Table 5 Summary of Ambient Monitoring Fluoride Results (24h)- SE Monitoring Location

	Fluoride – 24 h		
Monitoring Period	2004 - 12	2011 - 12	Criteria
Average Concentration (µg/m^3)	0.269	0.380	-
Standard Deviation (µg/m^3)	0.424	0.385	-
Minimum Concentration (µg/m^3)	0.015	0.062	-
Maximum Concentration (µg/m^3)	5.863	2.273	2.9

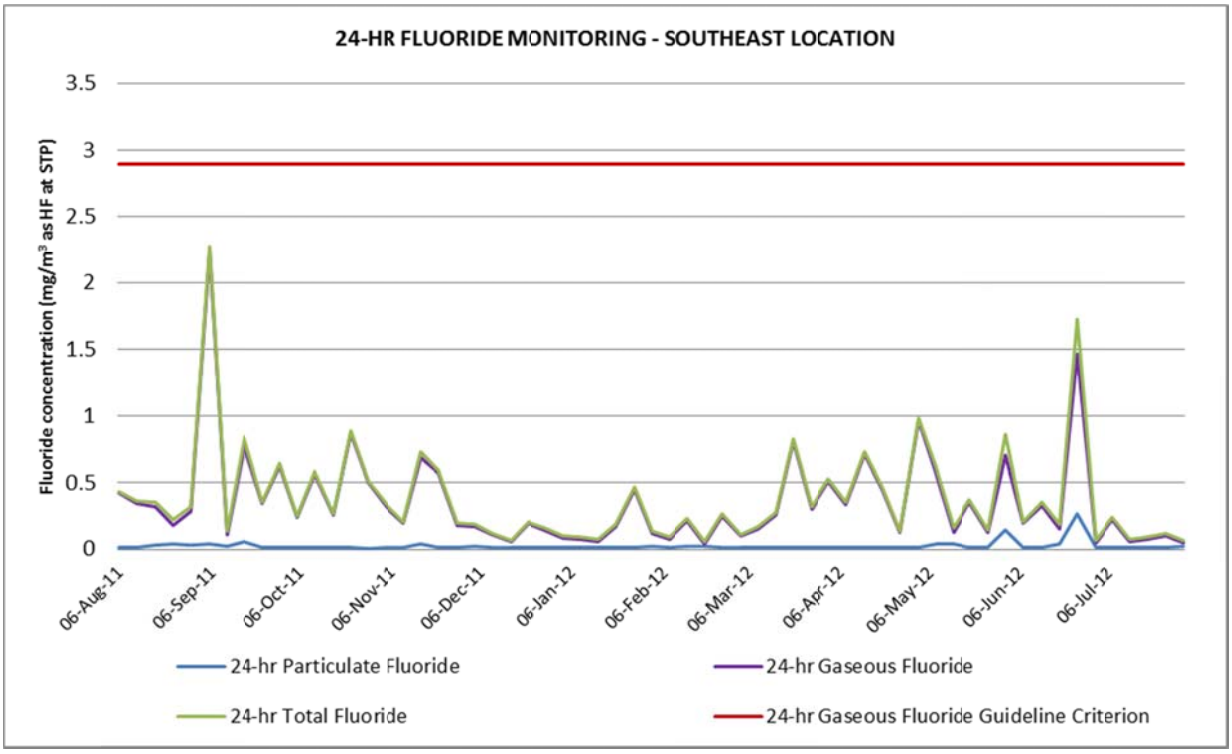

Figure 5 24-hour Fluoride Monitoring – Southeast Location

Fluoride concentrations for all 24 hour monitoring events at the SE monitoring location satisfied OEH criteria throughout the AEMR reporting period.

A comparison of the SE 24 hour Fluoride results obtained since commencement of operations (15 March 2004 to 31 July 2012) against data for the AEMR reporting period reveals the following:

- The average concentration of 24 hour Total Fluoride for the current year was higher than the long term average at SE sampling location (0.380µg/m^3 compared to 0.269 µg/m^3).
- The 24 hour Total Fluoride results recorded at the SE sampling location ranged from 0.015 µg/m^3 – 5.863 µg/m^3 (since commencement) and 0.062 µg/m^3 – 2.273 µg/m^3 (for the AEMR reporting period).

4.1.4 Fluoride – Weekly Monitoring Results

4.1.4.1 NW Monitoring Location

A summary of NW Weekly Fluoride results (15 March 2004 – 31 July 2012) and results from the AEMR reporting period are provided in **Table 6**. **Figure 6** graphs the results of the Weekly Fluoride monitoring events during the AEMR reporting period.

Table 6 Summary of Ambient Monitoring Fluoride Results (Weekly) - NW Monitoring Location

	Fluoride - weekly		
Monitoring Period	2004 - 12	2011 - 12	Criteria
Average Concentration (µg/m^3)	0.105	0.112	-
Standard Deviation (µg/m^3)	0.178	0.128	-
Minimum Concentration (µg/m^3)	0.000	0.000	-
Maximum Concentration (µg/m^3)	2.923	0.752	1.7

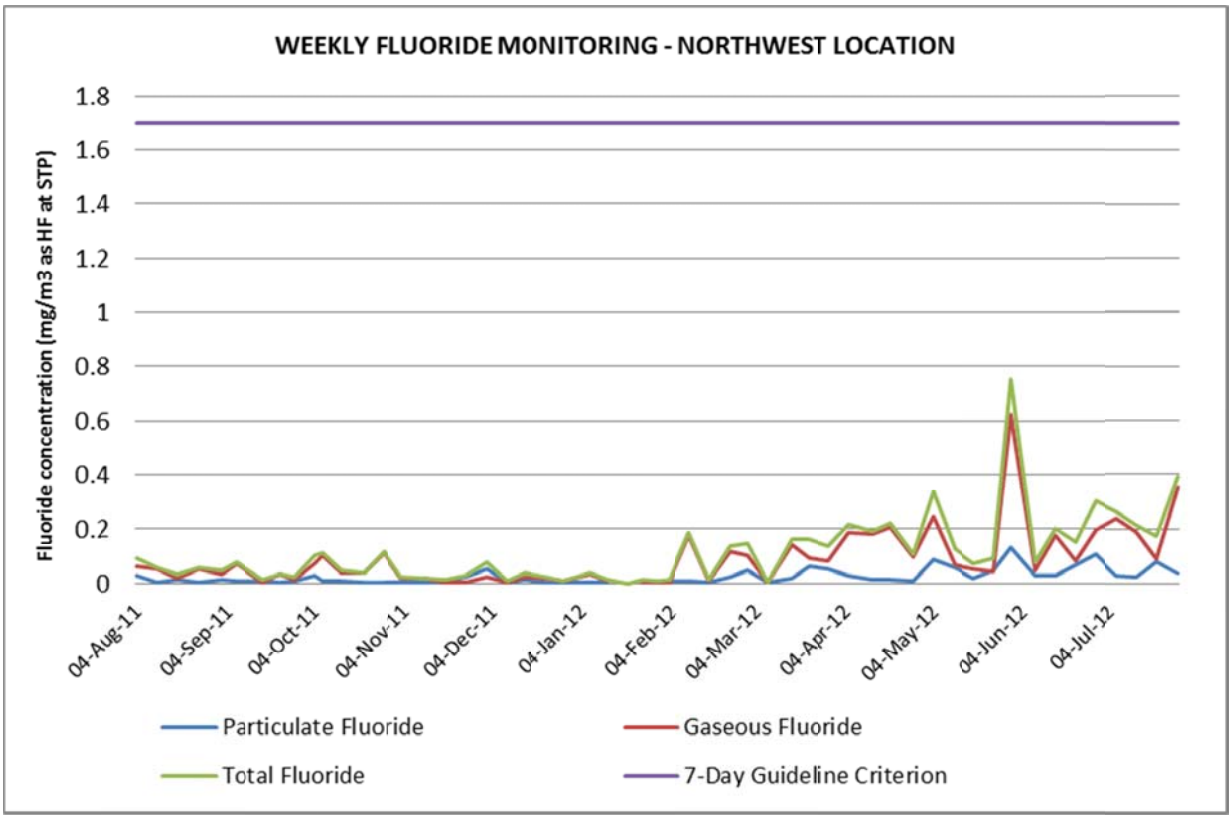

Figure 6 Weekly Fluoride Monitoring – Northwest Location

Fluoride concentrations for all weekly Fluoride monitoring events at the NW monitoring location satisfied OEH criteria throughout the AEMR reporting period.

A comparison of the NW Weekly Fluoride results gained since commencement of operations (15 March 2004 to 31 July 2012) against data for the AEMR reporting period reveals the following:

- The average concentration of Weekly Total Fluoride was higher than the long term average at the NW sampling locations (0.112 µg/m^3 compared to 0.105 µg/m^3).
- The Weekly Total Fluoride results recorded at the NW sampling location ranged from 0.000 µg/m^3 – 2.923 µg/m^3 (since commencement) and 0.000 µg/m^3 – 0.752 µg/m^3 (for the AEMR reporting period).

As reported to the OEH in the Annual Return (refer to **Appendix B**), the scheduled 24hr ambient Hydrogen fluoride sample was not collected in January 2012, due to power outage, and an additional make-up sample was not collected. The ambient air sampling procedure has been updated to include a requirement for one make-up sample to be taken for each missed, scheduled sample so that the required numbers of samples are obtained over the course of the year.

4.1.4.2 SE Monitoring Location

A summary of SE Weekly Fluoride results (15 March 2004 – 31 July 2012) and results from the AEMR reporting period are provided in **Table 7**. **Figure 7** graphs the results of the Weekly Fluoride monitoring events during the AEMR reporting period.

Table 7 Summary of Ambient Monitoring Fluoride Results (Weekly) - SE Monitoring Location

	Fluoride - weekly		
Monitoring Period	2004 - 12	2011 - 12	Criteria
Average Concentration (µg/m^3)	0.094	0.096	-
Standard Deviation (µg/m^3)	0.107	0.113	-
Minimum Concentration (µg/m^3)	0.003	0.003	-
Maximum Concentration (µg/m^3)	0.887	0.528	1.7

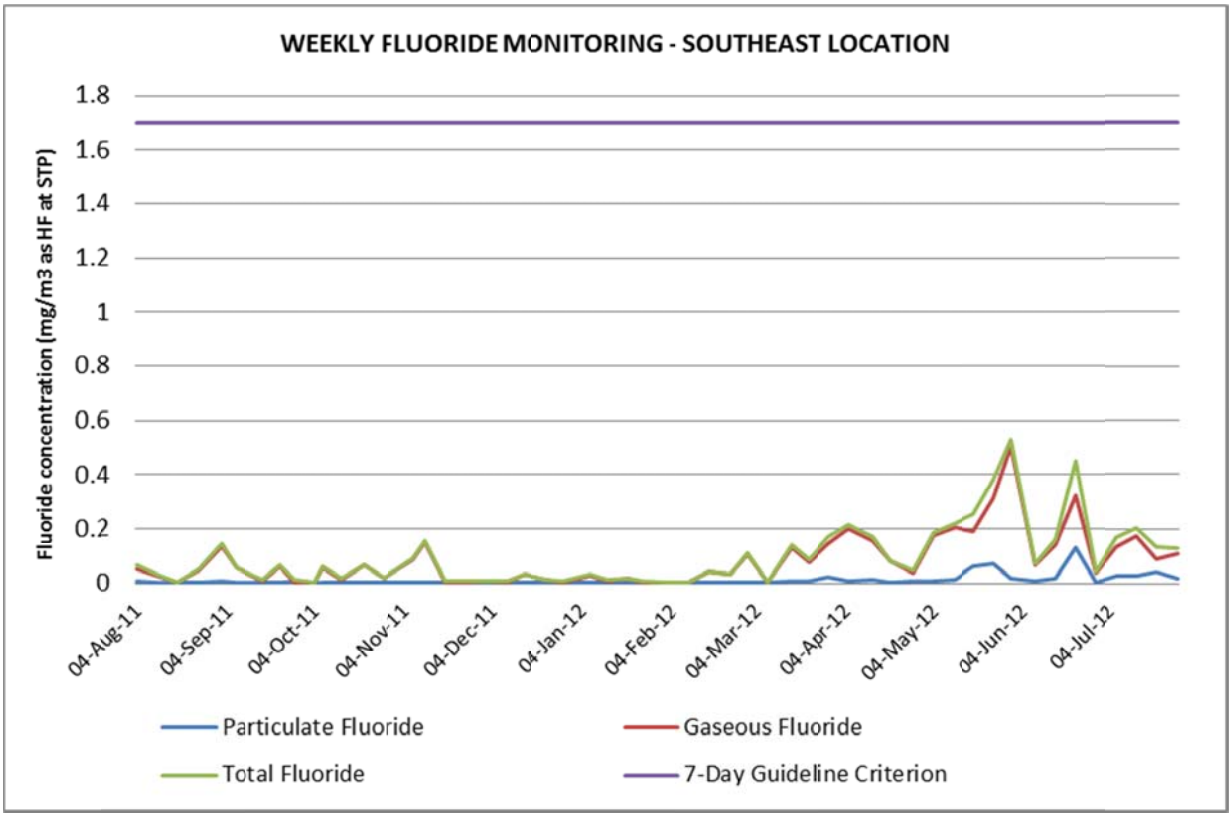

Figure 7 Weekly Fluoride Monitoring – Southeast Location

Fluoride concentrations for all weekly Fluoride monitoring events at the SE monitoring locations satisfied OEH criteria throughout the AEMR reporting period.

A comparison of the SE Weekly Fluoride results gained since commencement of operations (15 March 2004 to 31 July 2012) against data for the AEMR reporting period reveals the following:

- The average concentration of Weekly Total Fluoride was marginally higher than the long term average at the (0.096 µg/m^3 compared to 0.094 µg/m^3) sampling location.
- The Weekly Total Fluoride results recorded at the SE sampling location ranged from 0.003 µg/m^3 – 0.887 µg/m^3 (since commencement) and 0.003 µg/m^3 – 0.528 µg/m^3 (for the AEMR reporting period).

As reported to the OEH as part of the Annual Return (refer to **Appendix B**), the number of samples required to be taken during the reporting period was achieved.

4.2 Fluoride Impact on Vegetation

In accordance with EPL condition M7.1, the potential impact of fluoride emissions on surrounding flora was monitored by undertaking visual inspection for flora condition and by foliage sampling for fluoride content.

AECOM conducted an Annual Vegetation Condition Assessment on 13 December 2011 (**Appendix D**). Separate quarterly assessments were also undertaken during the reporting period by AECOM using the methodologies developed by Dr David Doley of the University of Queensland.

Foliage samples were collected from locations and vegetation types defined by the background survey for subsequent analysis. Samples chosen for fluoride content analysis were selected on the basis of species sensitivity toward fluoride, representation of certain species and vegetation type (over storey, cultivated vegetation and forage crops).

The results of the quarterly and annual fluoride assessment for the reporting period are summarised below.

4.2.1 Flora Condition Assessment

Table 8 describes the injury categories used to simplify the assessment process. Vegetation was assessed at locations selected previously, including on the NCIA works site and at locations that could be viewed from public land, plus a control site on private property at 200 Anambah Road.

Table 8 Symptom code for visible injury to vegetation, with particular reference to fluoride

Category	Tip necrosis or chlorosis % length	Marginal necrosis / chlorosis % width / area	Undulation / cupping	Anthocyanin accumulation % 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%

The quarterly visual assessments found slight chlorosis in a number of trees, which may be due to industrial emissions, including:

- *Angophora floribunda*, 100-104 Kyle Street;
- *Corymbia maculata*, NCIA entrance, Gardiner St, Gillette Close, Hilltop, Palisade Street, Regiment Road and Quarry Road;
- *Eucalyptus acmenoides*, Gillette Close;
- *Eucalyptus amplifolia*, within NCIA site, Maitland Saleyards and 100-104 Kyle Street;
- *Eucalyptus botryoides*, within NCIA site;
- *Eucalyptus robusta*, within NCIA site;
- *Eucalyptus moluccana* (coppice), within NCIA site;
- *Eucalyptus moluccana*, Maitland Saleyards;
- *Eucalyptus paniculata*, Gardiner Street, Maitland Saleyards and Quarry Road; and
- *Eucalyptus punctata*, Gardiner Street

Table 9 to **Table 11** (taken from the Annual Vegetation Condition Assessment at **Appendix D**) indicate the species that were assessed for visible injury.

Table 9 Condition assessment of selected monitoring sites located within NCIA

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 1 – Access road north of office															
Acacia longifolia	**1**	**1**	mixed	1	0	0	0	0	0	0	0	0	0	✓	Along northern fence opposite RSPCA
Eucalyptus robusta 1	**0**	**1**	0	0	0	0	0	0	1	1	0	0	✓	0	North end of shed
	1	**2**	1	0	0	0	0	0	1	2					
Eucalyptus robusta 2	**0**	**2**	0	0	0	0	0	0	2	0	0	0	0	0	Clay shed entry
	1	**2**	1	0	0	0	0	0	2	0					
Eucalyptus robusta 3	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	70 m north of office
	2	**2**	1	2	0	1	0	0	1	1					
Site 2 – Office car park															
Eucalyptus botryoides	**3**	**3**	0	3	2	2	0	0	1	2	0	0	0	0	
	2	**2**	1	2	2	2	0	2	1	2					
Eucalyptus robusta	**0**	**1**	0	0	0	0	0	0	0	1	0	0	0	0	
	0	**4**	1	0	0	0	0	0	2	4					
Fraxinus pennsylvanica	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Site 3 – Access road south of office															
Alaeocarpus sp.	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Acacia longifolia	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Site 4 – South-west corner of site															

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Acacia fimbriata	**1**	**1**	mixed	1	0	0	0	0	1	1	0	0	0	0	
Bursaria spinosa	**1**	**0**	mixed	1	0	0	0	0	0	0	0	0	0	0	
Dianella caerulea	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Eucalyptus amplifolia	**0**	**1**	0	0	0	0	0	0	1	1	1	0	0	0	
	2	**2**	1	2	1	0	0	1	1	2					
Site 5 – South-east corner of site															
Bursaria spinosa	**1**	**1**	mixed	1	0	0	0	0	0	0	1	0	0	✓	
Eucalyptus amplifolia	**0**	**4**	0	0	0	0	0	0	4	2	1	1	0	0	Coppice
	2	**3**	1	0	0	0	0	2	3	2					

Table 10 Condition assessment of selected monitoring sites located in the Rutherford residential area and Farley

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 6 – 3 Palisade Street															
Corymbia maculata 1	**0**	**4**	0	0	0	0	0	0	1	4	1	0	0	0	Front of the allotment (roadside)
	3	**3**	1	2	3	1	0	0	1	3					
Corymbia maculata 2	**-**	**-**	0	-	-	-	-	-	-	-	0	0	✓	0	Back of the allotment
	2	**2**	1	2	2	1	0	0	1	2					
Site 7 – Gillette Close															
Eucalyptus acmenoides	**0**	**3**	0	0	0	0	0	0	3	2	0	0	✓	0	
	2	**3**	1	2	1	1	0	0	3	2					
Bursaria spinosa	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Corymbia maculata	**0**	**3**	0	0	1	0	0	0	3	1	1	0	✓	0	
	2	**3**	1	2	2	1	1	0	3	2					
Lantana camara	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Site 8 – Regiment Road east of Dumont Court															
Acacia fimbriata	**0**	**2**	mixed	0	0	0	0	0	1	2	2	0	0	0	
Corymbia maculata	**-**	**-**	0	-	-	-	-	-	-	-	0	0	0	0	
	3	**3**	1	3	1	1	0	0	2	2					
Eucalyptus resinfera	**0**	**3**	0	0	0	0	0	0	1	3	0	0	✓	0	
	0	**2**	1	0	0	0	0	0	1	2					

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 9 – Regiment Road south-east of Squadron Crescent															
Bursaria spinosa	**2**	**2**	mixed	2	0	0	0	0	0	1	0	0	0	✓	
Corymbia maculata	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	
	0	**1**	1	0	0	0	0	0	1	0					
Eucalyptus resinfera	**0**	**1**	0	0	0	0	0	0	1	1	1	0	✓	0	
	1	**1**	1	0	0	1	0	0	1	1					
Site 10 – Wollombi Road between sewage works and creek															
Fraxinus excelsior	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	✓	
Grevillea robusta	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Pinus radiata	**0**	**1**	mixed	0	0	0	0	0	0	0	1	0	0	0	
Populus nigra var. *Italica*	**0**	**2**	mixed	0	0	0	0	0	1	1	2	0	0	0	
Site 11 – Hill top on Wollombi Road west of Owl Pen Lane, Farley															
Acacia baileyana	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Bursaria spinosa	**0**	**2**	mixed	0	0	0	0	0	0	0	3	0	0	✓	
Hakea gibbosa	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Corymbia maculata	**0**	**2**	0	0	0	0	0	0	2	1	1	0	0	0	
	3	**3**	1	3	1	1	1	2	2	2					
Eucalyptus moluccana	**0**	**2**	0	0	0	0	0	0	2	2	2	0	0	0	
	0	**4**	1	0	0	0	0	2	4	2					

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 12 – Western end of Quarry Road, Farley															
Corymbia maculata	**0**	**3**	0	0	0	0	0	0	3	2	1	0	0	0	
	1	**2**	1	0	0	1	0	0	2	1					
Eucalyptus paniculata	**0**	**1**	0	0	0	0	0	0	1	1	0	0	✓	0	
	0	**2**	1	0	0	0	0	0	2	1					
Pinus radiata	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	

Table 11 Condition assessment of selected monitoring sites located in the Rutherford Industrial area

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 13 – NCIA entrance, Racecourse Road															
Corymbia maculata	**2**	**2**	0	2	1	1	0	0	1	1	1	0	✓	0	Mistletoe infestation
	3	**3**	1	3	1	2	1	0	2	3					
Eucalyptus amplifolia	**0**	**2**	0	0	0	0	0	0	1	2	0	0	✓	0	
	0	**2**	1	0	0	0	0	0	1	2					
Site 14 – 100-104 Kyle Street															
Angophora floribunda	**0**	**4**	0	0	0	0	0	0	1	4	0	0	0	0	Mistletoe infestation
	2	**2**	1	2	1	1	0	1	2	2					
Eucalyptus amplifolia	**1**	**1**	0	1	0	1	0	0	1	2	1	1	✓	✓	
	2	**2**	1	0	0	1	0	0	2	1					
Site 15 – 11 Gardiner Road															
Corymbia maculata	**3**	**3**	0	3	2	3	0	0	0	1	0	0	0	0	
	1	**1**	1	1	1	1	1	0	1	1					
Eucalyptus fibrosa	**0**	**1**	0	0	0	0	0	0	1	1	0	1	✓	0	
	2	**2**	1	0	0	2	0	0	1	2					
Site 16 – 56 Gardiner Road															
Corymbia maculata	**-**	**-**	0	-	-	-	-	-	-	-	0	0	✓	0	Mistletoe infestation

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
	3	**3**	1	3	1	1	0	0	1	2					
Site 17 – Gardiner Road, Southern end															
Corymbia maculata	**1**	**2**	0	0	0	1	0	0	2	2	0	0	0	0	
	1	**1**	1	0	0	1	0	0	1	1					
Eucalyptus paniculata	**0**	**1**	0	0	0	0	0	0	1	0	0	0	✓	0	
	0	**1**	1	0	0	0	0	0	1	0					
Eucalyptus punctata	**1**	**2**	0	1	0	1	0	0	1	2	1	0	✓	0	
	2	**2**	1	1	0	2	0	0	1	1					
Site 18 – Maitland Saleyards, Kyle Street															
Corymbia maculata	**4**	**5**	0	0	4	1	0	0	1	5	0	0	✓	0	
	2	**2**	1	0	1	2	0	0	1	1					
Eucalyptus amplifolia	**1**	**1**	0	0	0	1	0	0	1	1	2	2	0	0	
	1	**2**	1	1	0	1	0	0	2	2					
Eucalyptus moluccana	**0**	**3**	0	0	0	0	0	0	3	1	0	0	0	0	
	1	**3**	1	0	0	0	0	1	3	2					
Eucalyptus paniculata	**0**	**5**	0	0	0	0	0	1	3	3	5	5	0	0	Old leaves not accessible to survey
	-	**-**	1	-	-	-	-	-	-	-					

The general condition of vegetation throughout the survey sites was satisfactory. Some vegetation appeared in a slightly healthier condition than that observed in the previous surveys. This may be linked to the above average rainfall observed in winter and spring 2011, resulting in extensive foliage growth and positive tree and shrub health.

The distribution of injury in both current season and one year old foliage indicates a correlation between emission injury and proximity to the NCIA stacks. The data indicate the extension of the zones of impact towards the northwest and south-east from the centre of the site, which is consistent with the kiln stacks being the principal source of fluoride emissions and the occurrence of prevailing south-easterly winds during the growing season for fluoride-sensitive species of *Eucalyptus*.

During the 2011 annual survey, the limit of impact from fluoride appeared to be within 2 km of the emission source.

The extent of leaf-chewing and sap sucking insect injury generally ranged from very slight to distinct. The occurrence and prevalence of insect attack appeared to be random and no pattern between location, species or foliage age could be established. However, at most sites insect attack constituted the dominant cause of injury to foliage.

4.2.2 Fluoride Content Assessment

Foliage samples for fluoride content assessment were collected from various established locations. Only current season leaves were collected. Grass cover at Wollombi Road (Site 11) was moderate, and samples were collected in a manner judged to simulate the foraging of grazing animals. Samples were sent to a NATA accredited laboratory for testing, and the results are provided in **Table 12**. A comparison of these results to previous years is provided in **Section 5.2.2** of this report.

Table 12 Sites and species within the survey area selected for foliage fluoride content assessment

Site	Location	Species	Fluoride Concentration (µg g^{-1})	
			Mixed	1-year-old
5	NCIA monitor site	*Eucalyptus amplifolia*	20.8	-
11	Hill-top Wollombi Rd	Mixed grasses	-	<10
13	NCIA entrance	*Eucalyptus amplifolia*	114	-
13	NCIA entrance	*Corymbia maculata*	13.5	-
15	11 Gardiner Rd	*Corymbia maculata*	48.9	-
19	200 Anambah Rd	*Vitis vinifera*	<10	-

4.3 Meteorological Monitoring

Meteorological data is sourced from the meteorological station established at the southeast air monitoring site. The weather station is sited and operated in accordance with approved methodologies (NSW EPA, 2001) 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 located at the site to provide daily average rainfall rates.

The dominant function of meteorological monitoring at NCIA is to gain an understanding of the influence that NCIA operations and background pollutant sources have on the results of the ambient air quality monitoring program. This is particularly important in relation to the analysis of ambient air monitoring results which exceed the relevant criteria (refer to **Section 4.1**) and possible air quality complaints (refer to **Section 3.0**).

The monthly trend graphs for temperature, rainfall, wind speed, and wind direction are provided in **Figure 8** to **Figure 21**.

Review of the monthly wind roses, presenting wind speed and direction for the reporting period (provided in **Figure 10** to **Figure 21**), reveals the following:

- In August and September 2011 wind was blowing predominantly from the west south west direction;
- In October 2011 wind was blowing from the west south west and east directions;

- In November 2011 through to February 2012 wind was blowing predominantly from the east and south east directions;
- In March 2012 winds were blowing predominantly from the east and south-east directions;
- From April 2012 through to July 2012 wind was blowing predominantly from the south-west direction; and
- Wind speeds recorded over the year from the NCIA on-site weather station were generally low to medium with an annual average wind speed of 1.47 m/s. Maximum hourly average wind gust was recorded at 9.9 m/s on 20 September 2011.

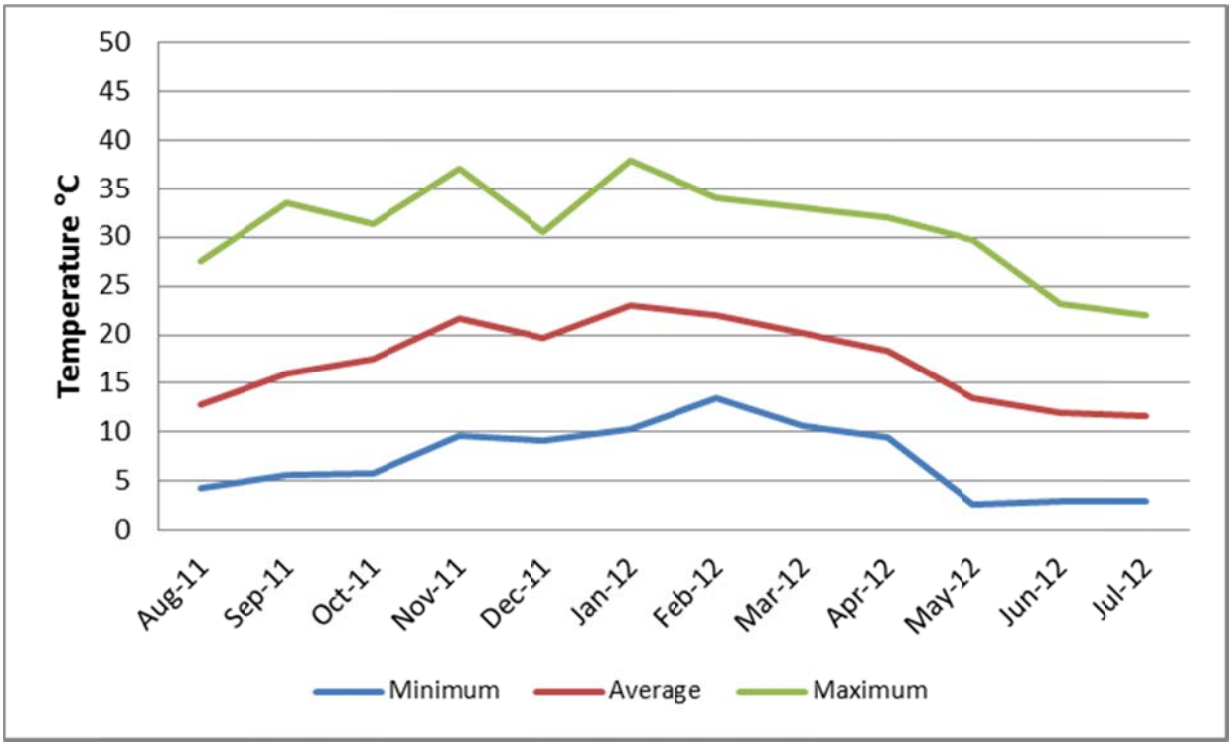

Figure 8 Temperature Range on 5m (August 2011 – July 2012)

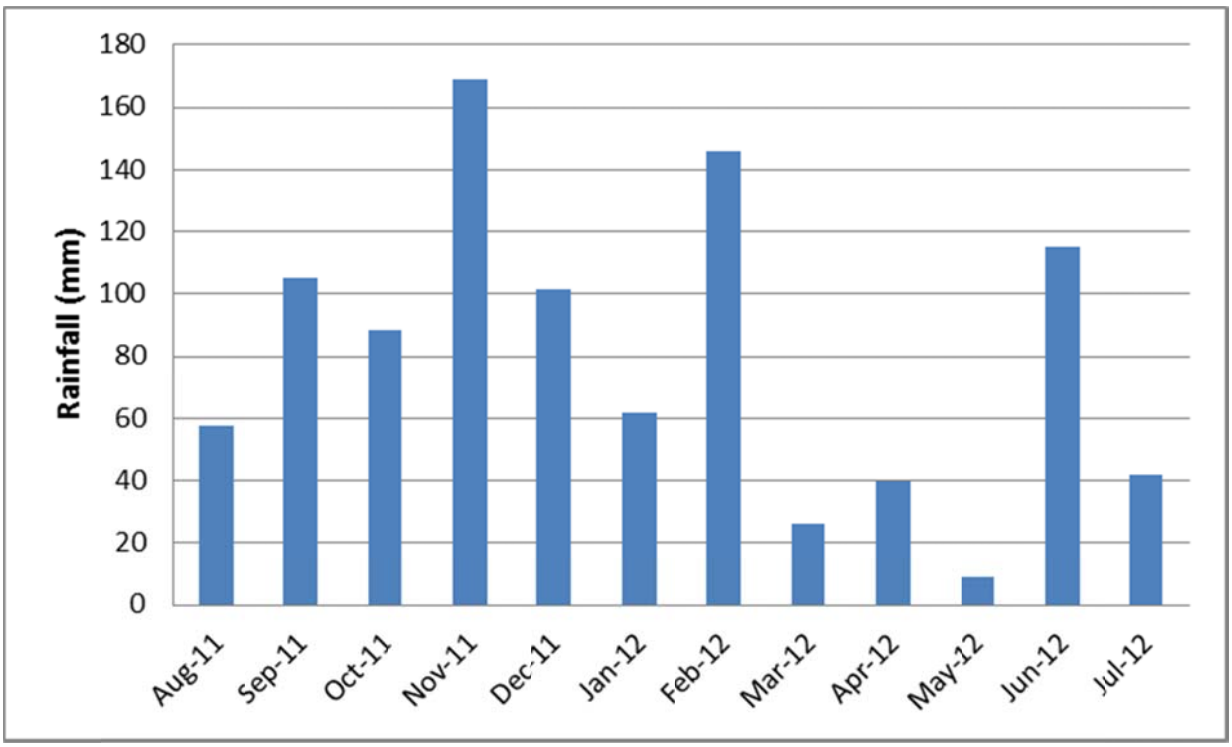

Figure 9 Rainfall (August 2011 – July 2012)

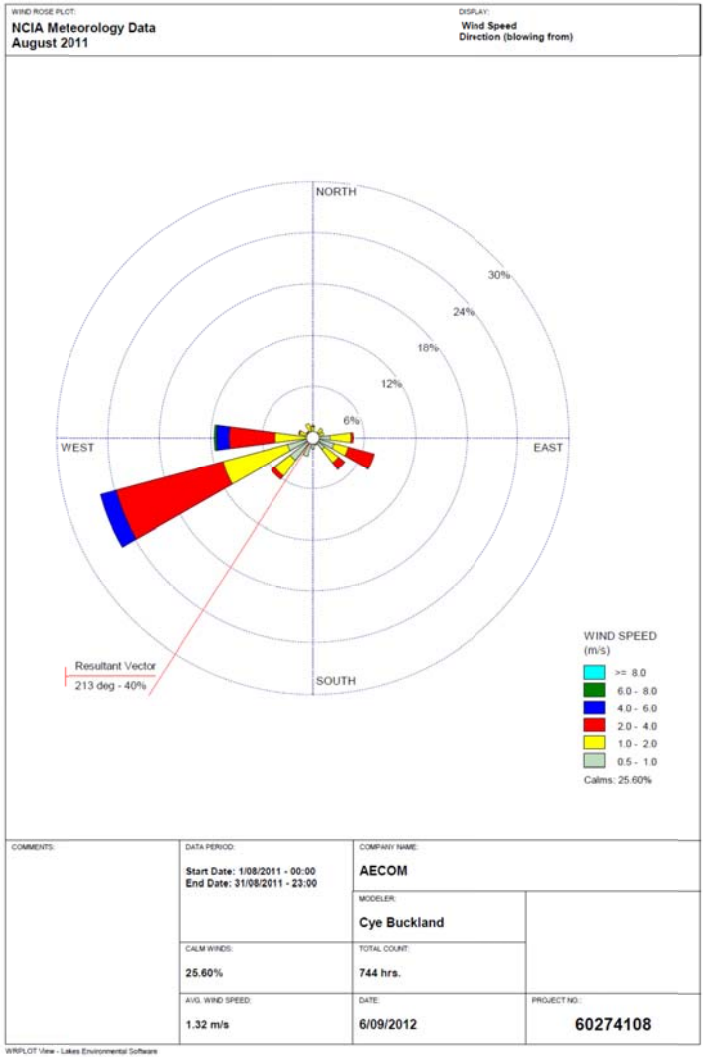

Figure 10 Wind Direction August 2011

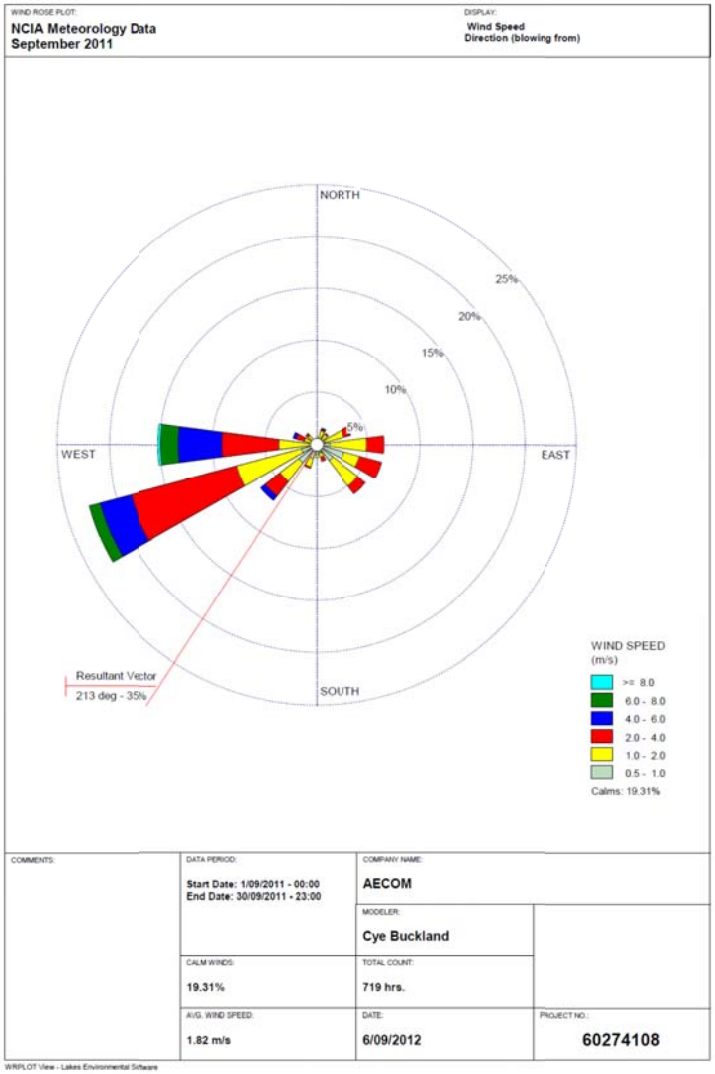

Figure 11 Wind Direction September 2011

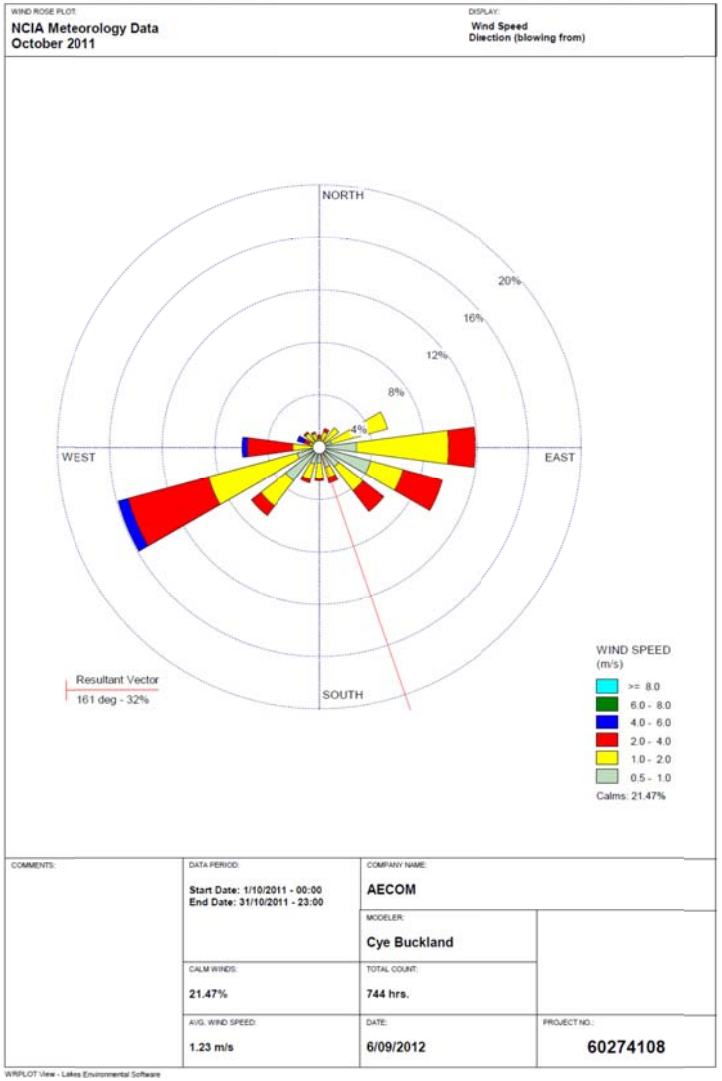

Figure 12 Wind Direction October 2011

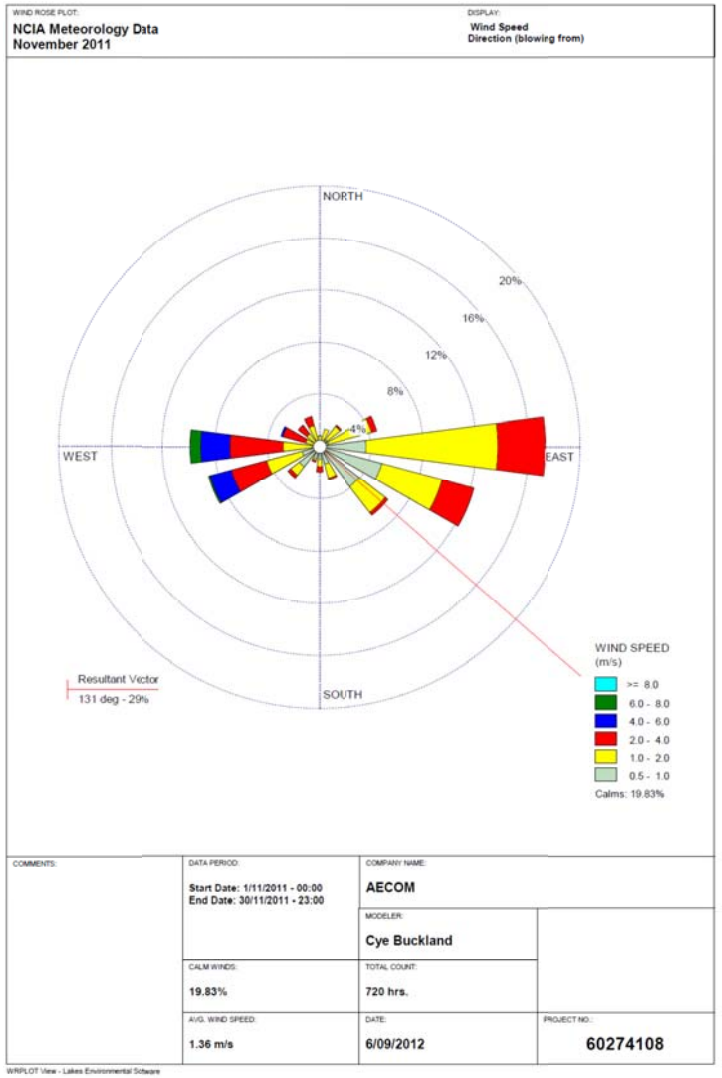

Figure 13 Wind Direction November 2011

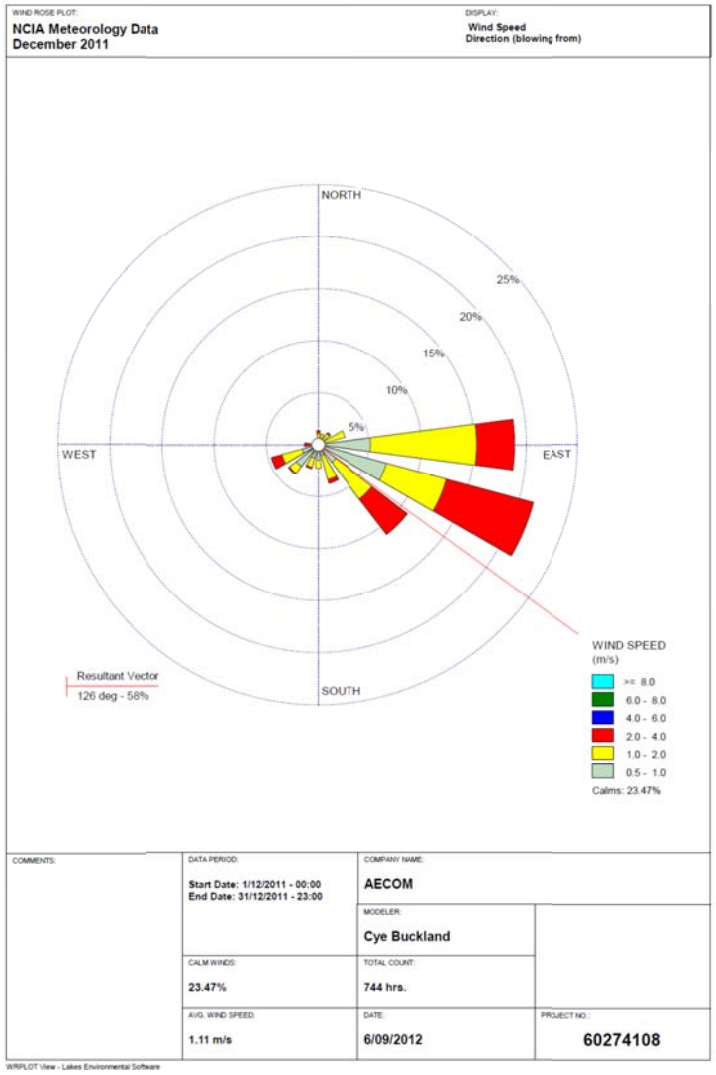

Figure 14 Wind Direction December 2011

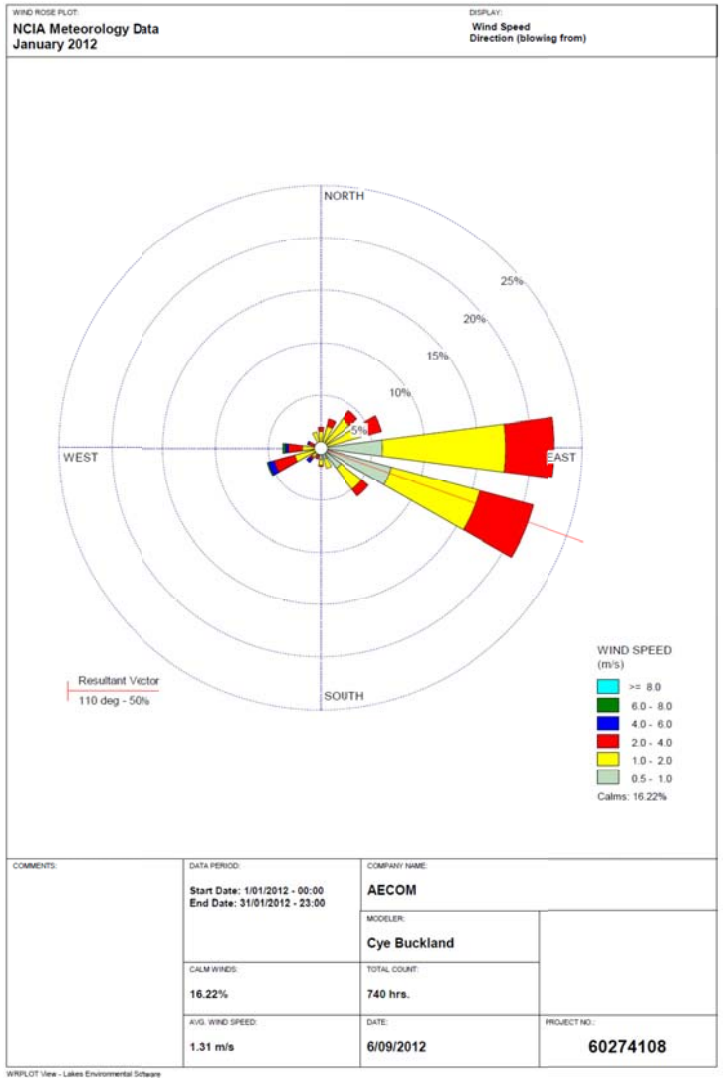

Figure 15 Wind Direction January 2012

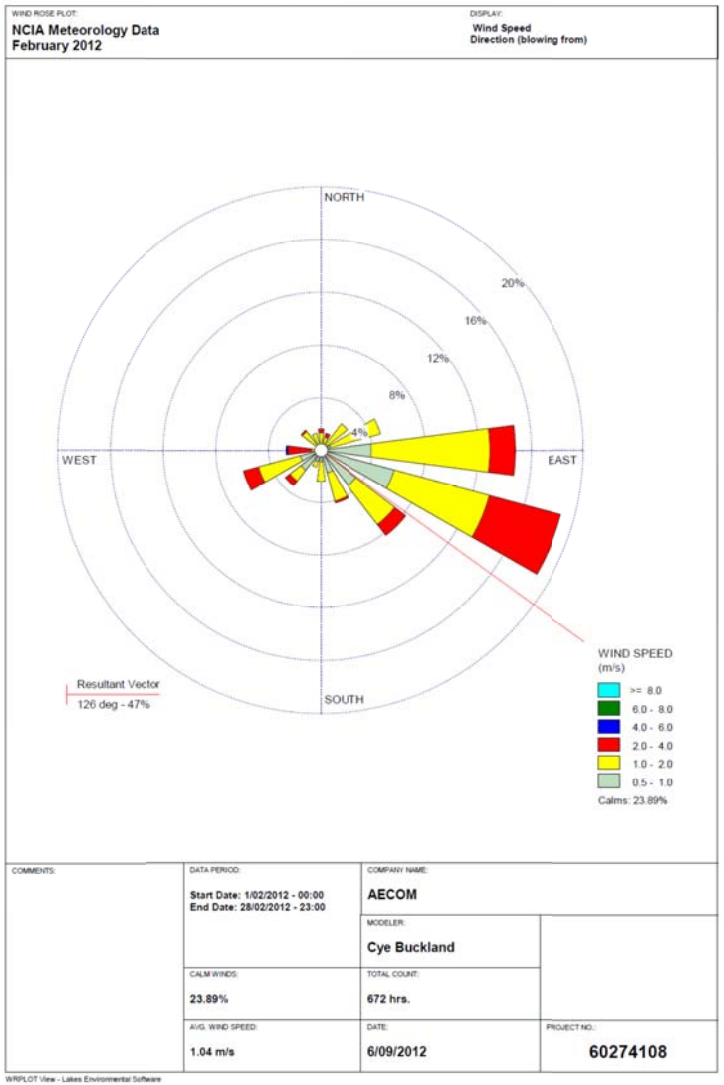

Figure 16 Wind Speed and Direction February 2012

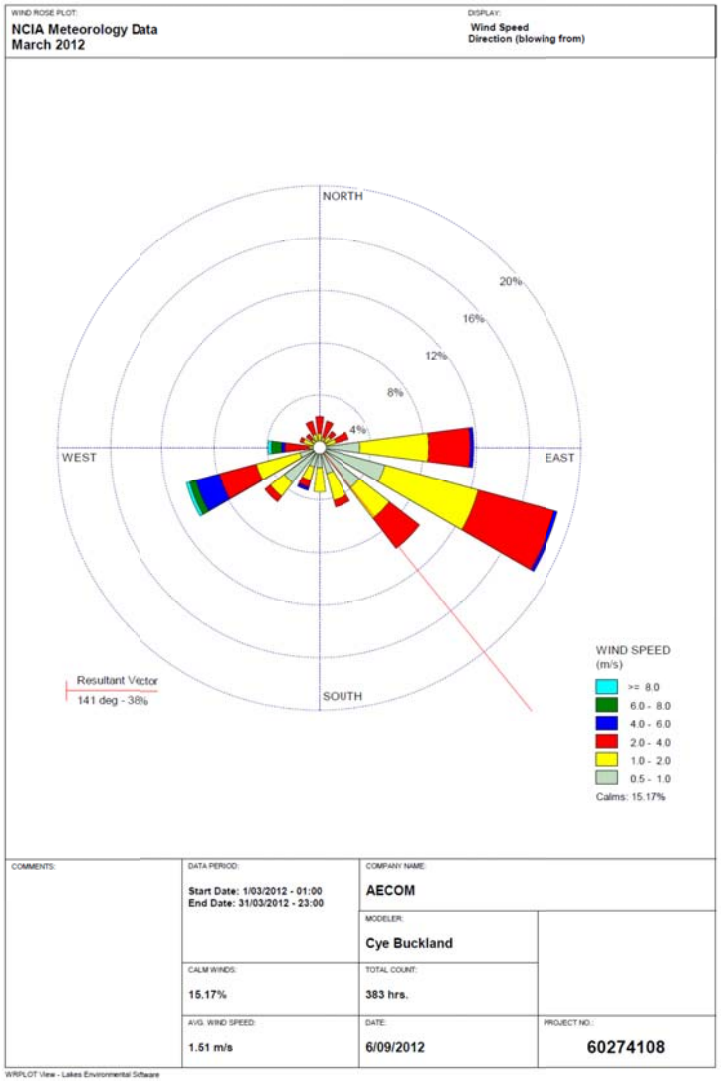

Figure 17 Wind Speed and Direction March 2012

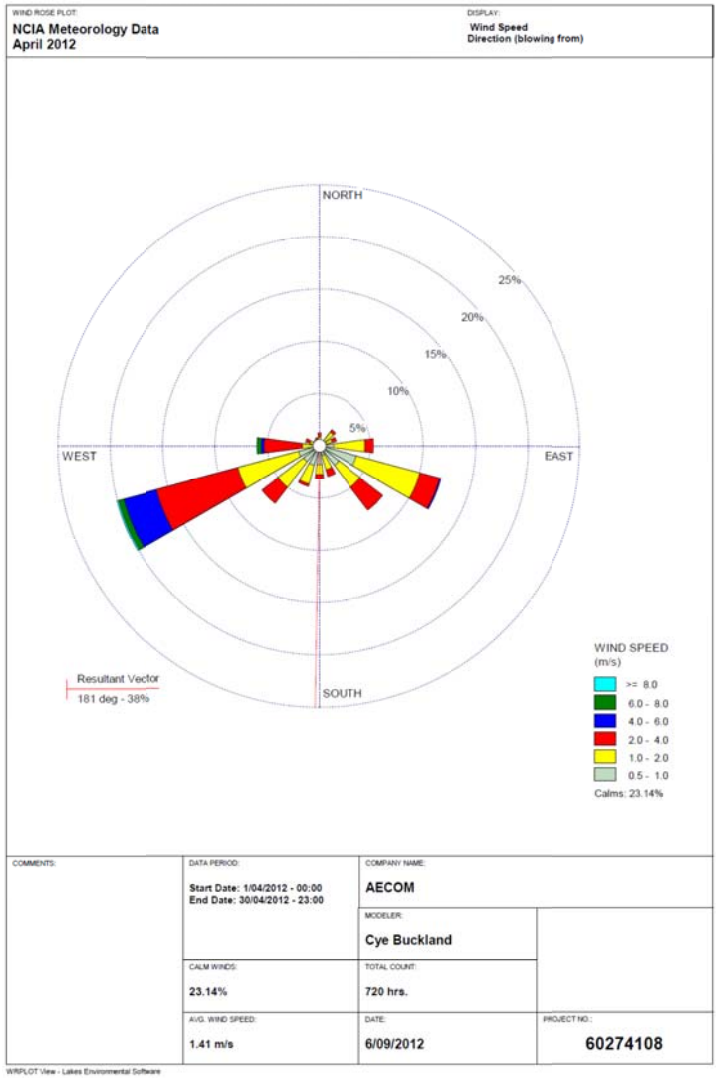

Figure 18 Wind Speed and Direction April 2012

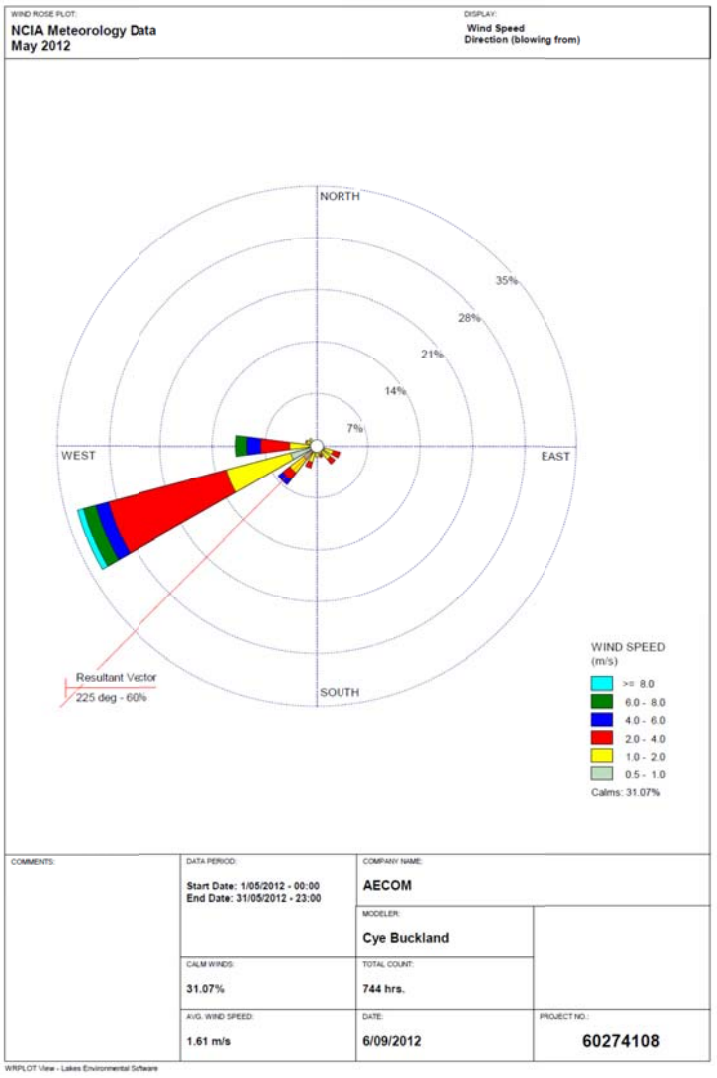

Figure 19 Wind Speed and Direction May 2012

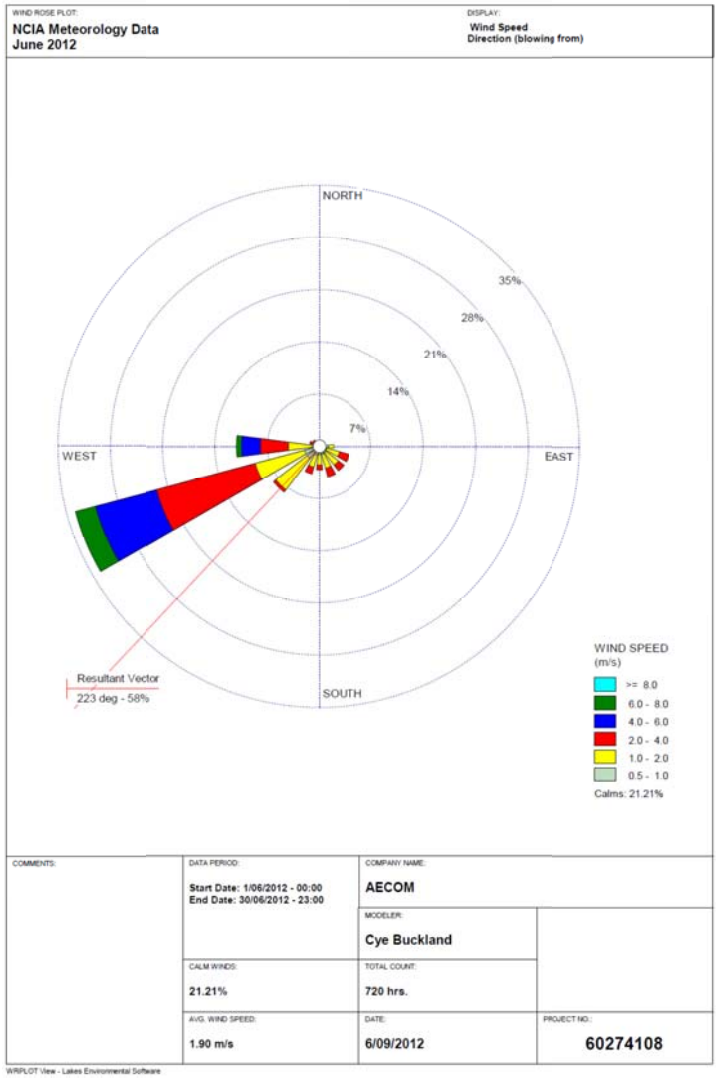

Figure 20 Wind Speed and Direction June 2012

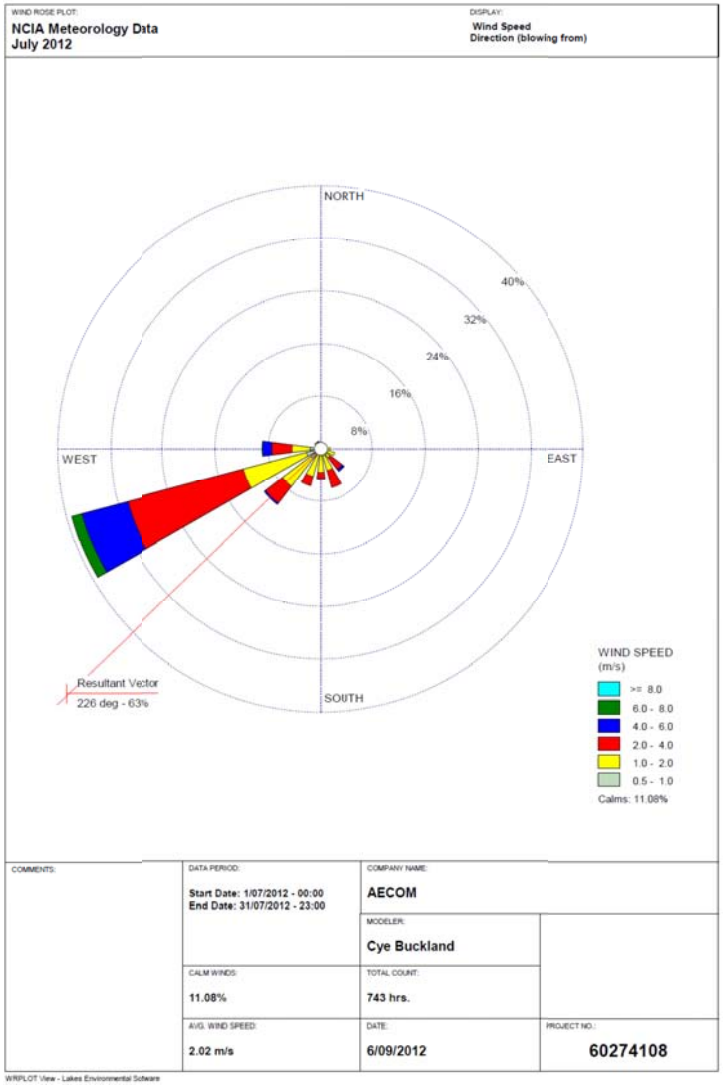

Figure 21 Wind Speed and Direction July 2012

4.4 Stack Emissions Testing

Annual stack emissions testing of the facility was conducted during August and September 2011. Emission sources assessed during the testing period are defined in **Table 13**.

Table 13 Emission Source Descriptions

OEH Identification Number (EPL)	Emission Source Description
1	Clay Preparation (CP1)
3	Pressing and Drying (PD1)
5	Dryer (D1)
6	Dryer (D2)
9	Glaze Line
10	Selection Line (SL1234)
12	Spray Dryer (SD1)
14	Kiln 1 (KP1)
15	Kiln 2 (KP2)
18	Hot Air Cooler 1 (HAC1)
19	Hot Air Cooler 2 (HAC2)

All sources were tested for Total Particulate Matter and Fine Particulate (PM_{10}). Additional testing conducted on the Kiln 1 and Kiln 2 stacks measured concentrations of total fluoride, sulfuric acid mist (H_2SO_4 as SO_3), sulfur dioxide (SO_2 as SO_3), hazardous substances (metals), oxides of nitrogen (NO, NO_2, NO_x), cadmium and mercury. All sampling was conducted in accordance with the applicable OEH test methods, with analyses conducted by a NATA-accredited laboratory.

The pollutant discharge limits for the facility (from the Consent and the EPL) are shown in **Table 14**. Summaries of the emission testing results are provided in **Table 15** - **Table 17** and **Appendix E**.

All emission concentrations are converted to standard conditions of 0 °C, dry gas and 1 atmosphere pressure for comparison with appropriate regulatory limits. In the past the Consent and EPL have required the NOx, Total Particulate and Fine Particulate (PM_{10}) emission concentrations to be corrected to 7% O_2. In March 2011 NCIA's Consent was modified to amend the oxygen correction factor to 18% to better reflect the design of equipment used in NCIA's operation. The EPL was accordingly updated (dated 7 November 2011) incorporating the 18% oxygen correction. The NO_x, Total Particulate and PM_{10} emission concentrations determined within Kiln stack exhausts have therefore been corrected to 18% O_2.

Concentrations of all pollutants were below the limits specified for each source in the EPL.

Table 14 Pollutant Discharge Limits

Pollutant	Emission Source	Concentration Limit (mg/m^3)
Solid particles	Point 1 - Clay preparation area	20
	Point 3 - Pressing and drying area	
	Point 5 – Dryer (D1)	
	Point 6 – Dryer (D2)	
	Point 9 - Glaze line	
	Point 10 - Selection line	
	Point 12 - Spray drier	
	Point 14 – Kiln 1	
	Point 15 – Kiln 2	
	Point 18 - Hot air cooling system 1	5
	Point 19 - Hot air cooling system 2	5
Cadmium	Point 14 & 15 – Kiln 1 & Kiln 2	0.1
Mercury		0.1
Nitrogen dioxides		100
Hazardous substances		1
Hydrogen fluoride		5
Sulphuric acid mist and sulphur trioxide (as SO_3)		100

Table 15 Summary of Compliance Emission Assessment Results

Stack	Fine Particulate (PM_{10}) (mg/m^3)	Total Particulate (mg/m^3)	Regulatory Limit (mg/m^3)*
Clay Preparation (CP1) (EPL 1)	<0.13	1.7	20
Pressing and Drying (PD1) (EPL 3)	1.4	8.6	20
Dryer (D1) (EPL 5)	0.74	2.4	20
Dryer (D2) (EPL 6)	<0.3	0.82	20
Glaze Line (EPL 9)	<0.2	<0.22	20
Selection Line (SL 1,2,3,4) (EPL 10)	<0.13	0.19	20
Spray Dryer (SD1) (EPL 12)	1.4	7.9	20
Hot Air Cooler (HAC 1) (EPL 18)	<0.19	2.7	5
Hot Air Cooler (HAC 2) (EPL 19)	<0.36	<0.83	5

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

Table 16 Summary of Compliance Emission Assessment Results - Kiln 1 & Kiln 2

Pollutant	Kiln 1 (EPL 14)	Kiln 2 (EPL 15)	Regulatory Limit
Fine Particulate (at 18% O_2) (PM_{10}) (mg/m^3)	<0.12	0.024	N/A
Total Particulate (at 18% O_2) (mg/m^3)	<0.1	0.044	20
Total Fluoride (as HF) (mg/m^3)	0.58	0.19	5
Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	1.7	6.7	100
Sulfur Dioxide (SO_2 as SO_3) (mg/m^3)	81	93	NA
Total Hazardous Substances (Metals) (mg/m^3)	0.12	0.1	1
Total Oxides of Nitrogen (at 18% O_2) (as Equivalent NO_2) (mg/m^3)	68	69	100
Cadmium (mg/m^3)	0.0042	0.0013	0.1
Mercury (mg/m^3)	0.0069	0.0062	0.1

Table 17 Summary of Average Stack Discharge Velocities for 2005-2012 Reporting Period

Stack	Average Exit Velocity 2005-2012 (m/s)	Exit Velocity 2010-2012 (m/s)	Minimum Stack Discharge Velocity (m/s)
Clay Preparation (CP1) (EPL 1)	**15.0**	**14**	17.5
Pressing and Drying (PD1) (EPL 3)	**11.7**	**14**	17.7
Dryer (D1) (EPL 5)	10.2	9.9	5.2
Dryer (D2) (EPL 6)	10.2[1]	10	5.2
Glaze Line (EPL 9)	**12.1**	**14**	16
Selection Line (SL 1,2,3,4) (EPL 10)[2]	**3.4**	**5.9**	15.7
Spray Dryer (SD1) (EPL 12)	**21.0**	22	21.9
Kiln (KP1) (EPL 14)[3]	**14.6**	**15**	26
Kiln (KP2) (EPL 15)[3]	**13.7[1]**	**13**	26
Hot Air Cooler (HAC 1) (EPL 18)	28.2	28	17.4
Hot Air Cooler (HAC 2) (EPL 19)	19.3[1]	18	17.4

Bold type indicates exceedance of Development Consent criteria

[1] These averages are for 2009-2012 only. No long term data available as stage 2 began operation in 2009

[2] Measured velocities are for stage 2 only. It is expected these velocities will increase above criteria when stage 4 is in full operation.

[3] Alternative criteria have been set for the expansion EA that are based on efficient operator measurements. These requirements were based on manufacturer's guarantees that in some instances have proven to be inappropriate. It is expected that the new requirements defined by OEH in their response to the EA will apply in the future

4.5 Noise

Noise levels were measured in accordance with NCIA's EPL (2004) and the procedures in the NSW Industrial Noise Policy (INP) (NSW EPA, 2000). The NSW INP states that: *a "development will be deemed to be in non-compliance with noise consent or license condition if the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence condition."*

The noise monitoring was undertaken by the Spectrum Acoustics on 18 June 2012, during the day, evening and night time periods. Any data obtained during rainfall, wind speeds greater than 3 m/s or during intense temperature inversions between 6pm and 7am were omitted. Full details of the noise assessment are provided in **Appendix F**.

A series of attended noise measurements, of 15 minutes duration, were made in Kenvil Close and in Wollombi Road on Monday 18 June 2012 during the day, evening and night time periods. Measurements were also made on during the day time period at the NCIA site.

Table 18 shows a summary of observations made during the 2012 noise assessment, where they are compared against noise levels specified in the Consent and the EPL.

Table 18 Attended Noise Measurements

RECEIVED NOISE LEVELS – 29/30 JUNE 2011					
Location	**Time**	**dB(A),Leq (15 min)**	**Wind speed/ direction**	**Identified Noise Sources**	**Criterion* dB(A) Leq (15 min)**
Kenvil Close	1:10 pm	**47**	1.5/NW	Other industry (46), traffic (38) birds (33), **NCIA not measureable**	41
Kenvil Close	9:00 pm	**51**	1/NW	Other industry (46), frogs (41), distant traffic (30), **NCIA not measureable**	39
Kenvil Close	10:50 pm	**47**	0.5/N	Other industry (45), frogs (42), **NCIA not measurable**	35
Wollombi Road	1.30 pm	**64**	1.5/NW	Local traffic (64), other industry (40), trains (38), **NCIA not measureable**	41
Wollombi Road	9.25 pm	**65**	2.0/NW	Local traffic (65), other industry (41), traffic (41), **NCIA not measureable**	39
Wollombi Road	10.30 pm	**37**	0.5/N	Other industry (37), **NCIA not measureable**	35

* Development Consent and Environment Protection Licence

The results in **Table 18** show that the received noise from the NCIA site was not directly measureable during the monitoring survey. The measurements were inconclusive as the acoustic environment of both sites was dominated by emissions from other industries not related to NCIA.

Theoretical calculations were carried out to predict received noise levels under neutral atmospheric conditions. The predicted noise levels were in compliance with the noise criteria for all time periods.

There were no discernible L1 (1 min) events from NCIA during any of the measurements. The only L1 (1 min) industrial noise came from another industrial site not related to NCIA.

Based on these observations and theoretical calculations, the noise contribution from NCIA operations was estimated at the nearest sensitive receptor and was found to comply with noise criteria specified in the Consent and EPL.

4.6 Water Usage

Figure 22 below shows weekly process water usage over the current reporting period recorded at NCIA main entrance water meter. The data shows similar weekly water usage throughout the reporting period, with the exception of the December/January period during annual plant shutdown. The average weekly water usage for the current reporting period was 377 kL, which has decreased slightly compared to the previous reporting period (weekly water usage 397kL).

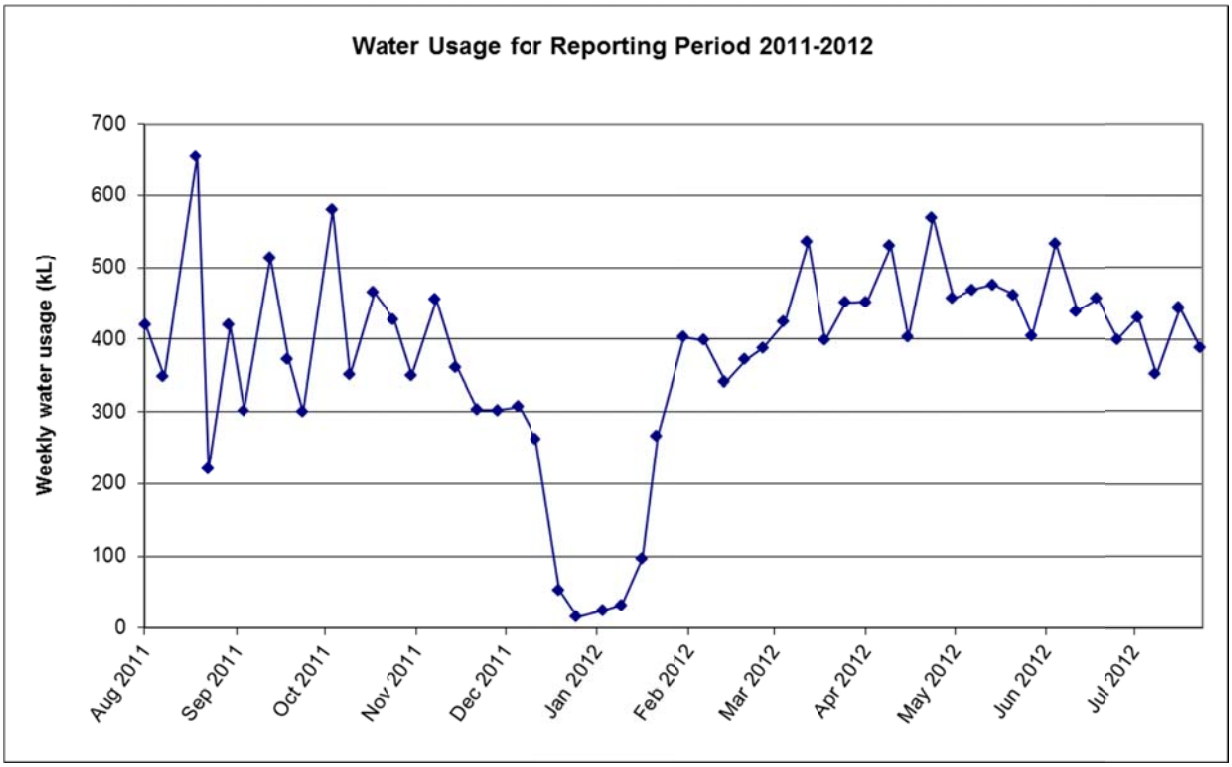

Figure 22 Water Usage for Reporting Period 2010 – 2012

5.0 Environmental Impacts and Performance

The monitoring requirements specified for the facility in the EPL and outlined in **Section 4** were used as a guide for the assessment of environmental impacts and performance of the facility in the reporting period against EIS predictions and against historical results. As such, the assessment includes ambient air quality, fluoride in vegetation, stack emissions and noise impacts.

5.1 Ambient Air Quality

It was predicted in the EIS that PM_{10} levels may exceed the relevant OEH criteria, primarily as a result of background levels already exceeding the criterion. Hydrogen fluoride levels were expected to meet the relevant criteria. The ambient air quality monitoring results (PM_{10} and hydrogen fluoride) are generally consistent with these predictions. There were two exceedances of the OEH criteria for PM_{10} (one at NW and one at SE monitoring location) with background levels the most likely cause of all exceedances, as discussed in **Section 4**.

5.1.1 Trends

A comparison of the PM_{10} and hydrogen fluoride historical results gained since commencement of operations (15 March 2004 to 31 July 2012) against data for the AEMR reporting period is discussed in **Section 4**. Graphs displaying long-term (2004 to 2012) ambient air monitoring data for PM_{10} and hydrogen fluoride are provided below in **Figure 23** – **Figure 28**.

In general the figures show variable results oscillating about an average which shows a decreasing trend in the NW location (**Figure 23**) and oscillating about a relatively stable average in the SE location (**Figure 26**).

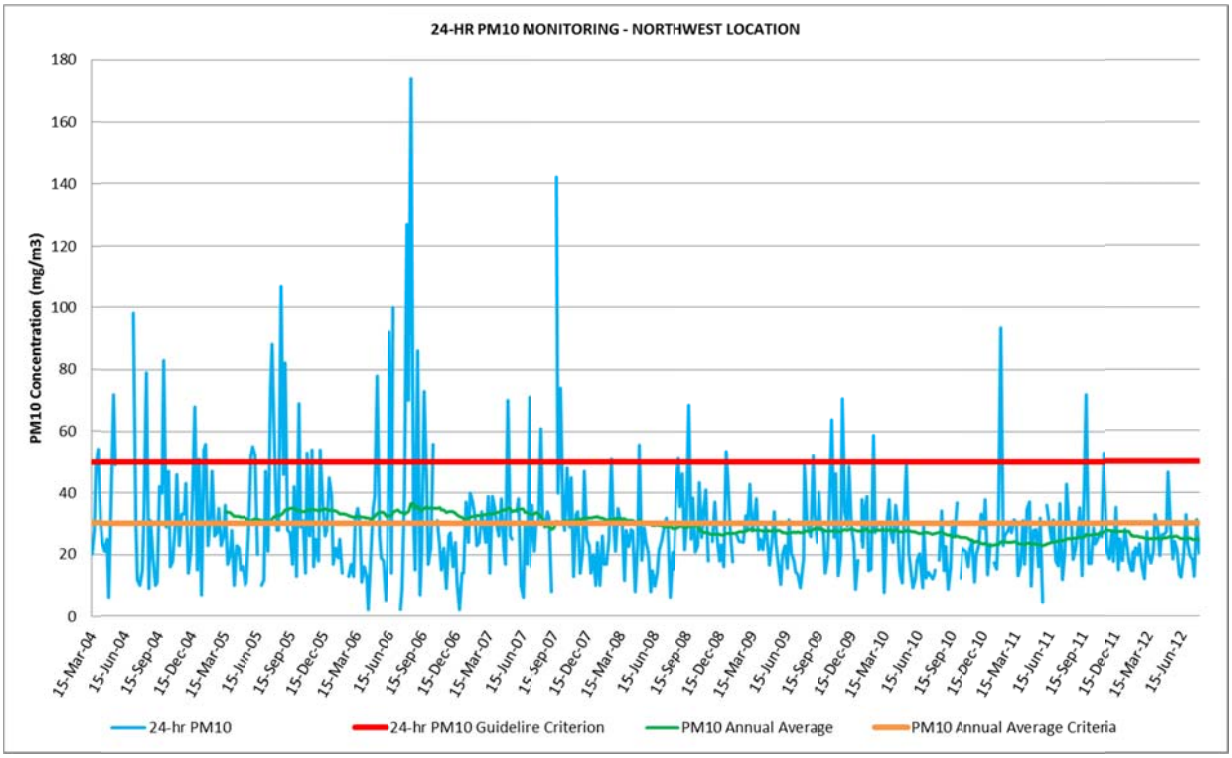

Figure 23 24 hour PM_{10} Monitoring – Northwest Location 2004 - 2012

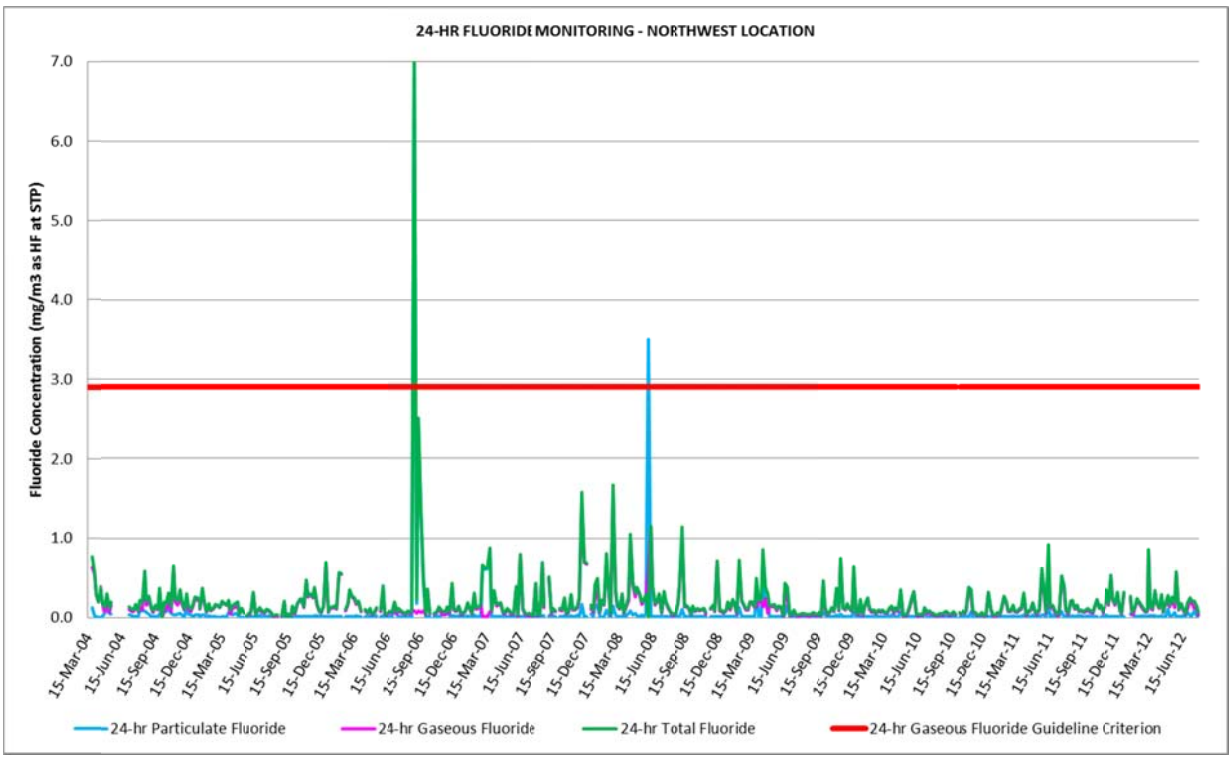

Figure 24 24 hour Fluoride Monitoring – Northwest Location 2004 - 2012

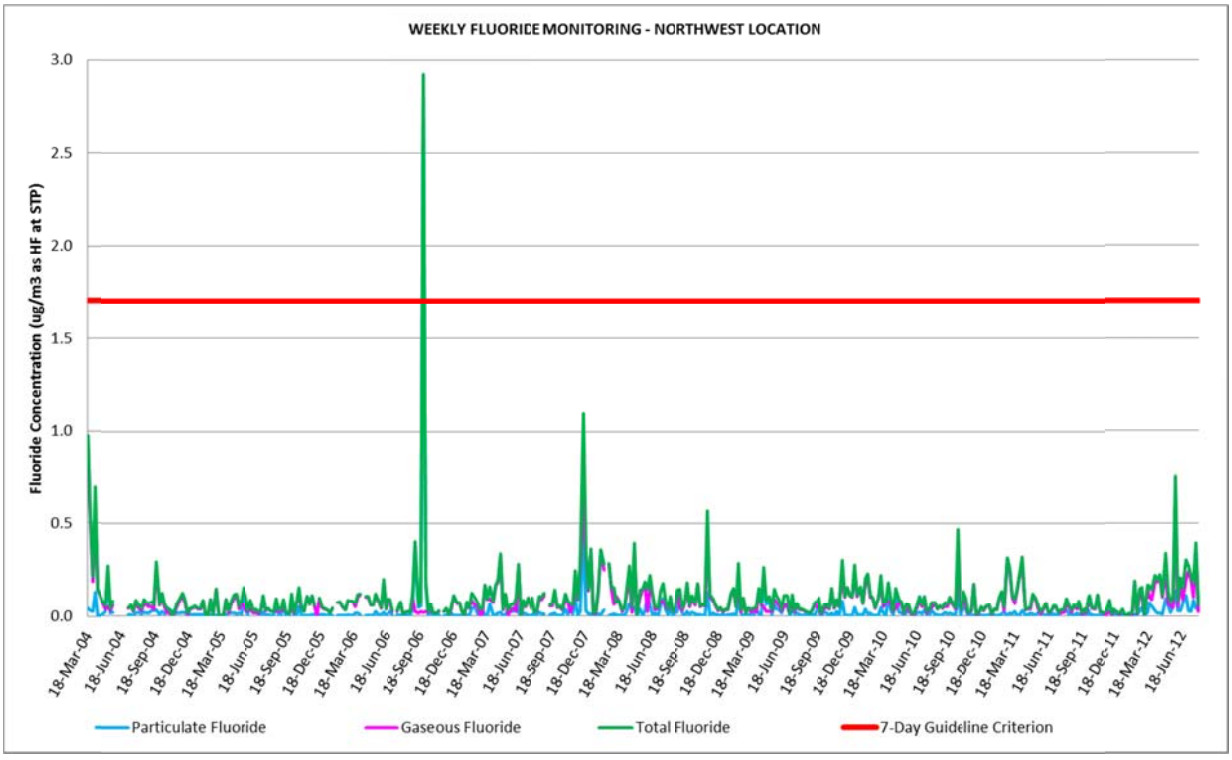

Figure 25 Weekly Fluoride Monitoring – Northwest Location 2004 - 2012

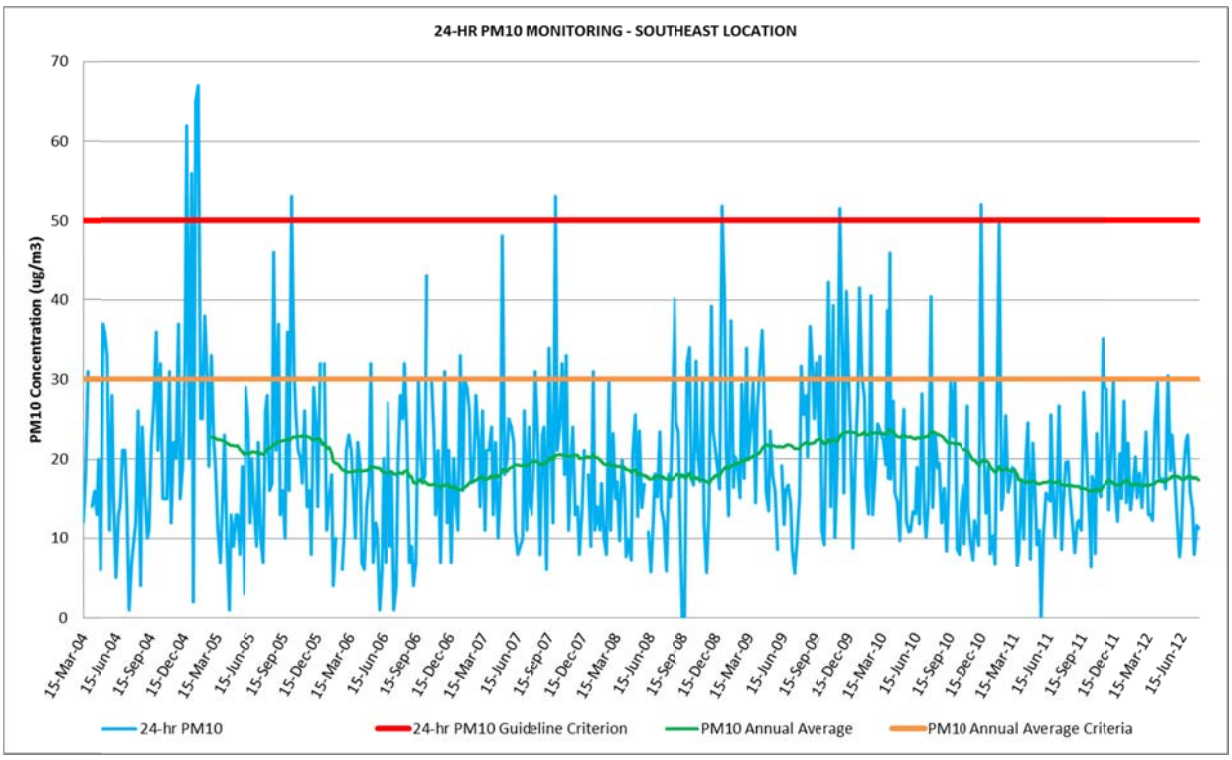

Figure 26 24 hour PM10 Monitoring – Southeast Location 2004 - 2012

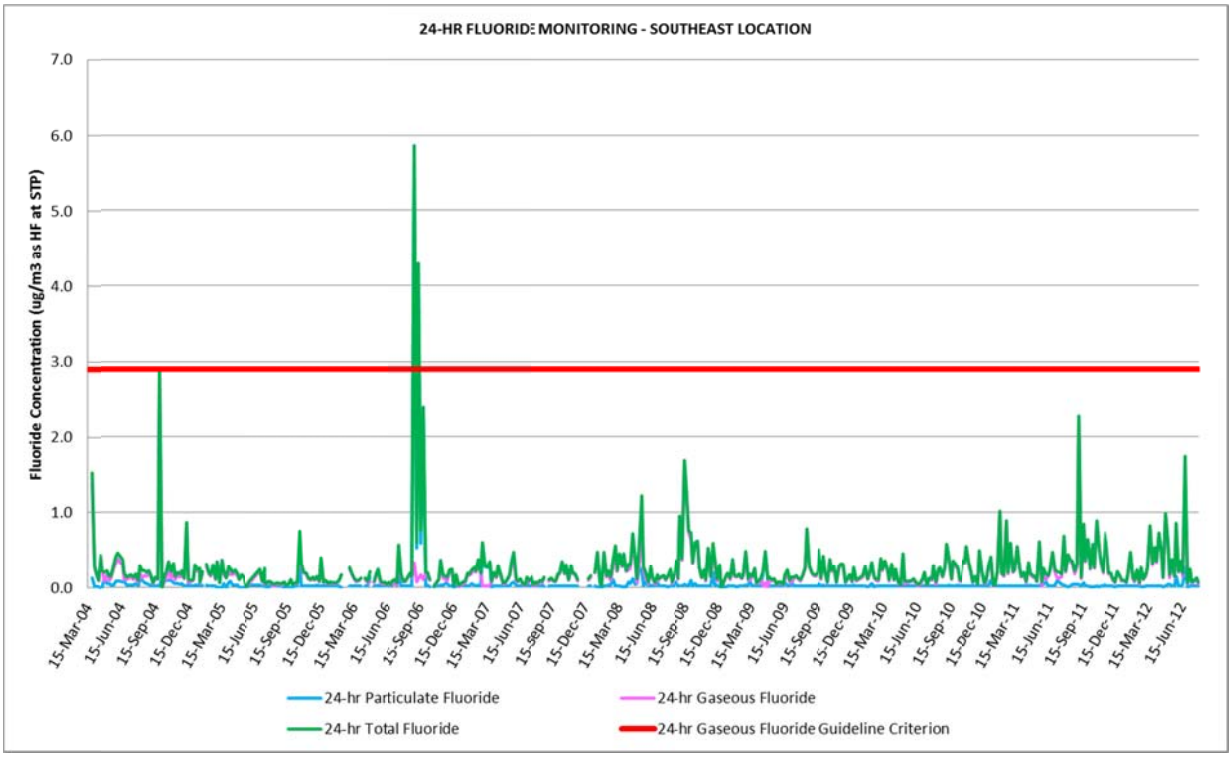

Figure 27 24 hour Fluoride Monitoring – Southeast Location 2004 - 2012

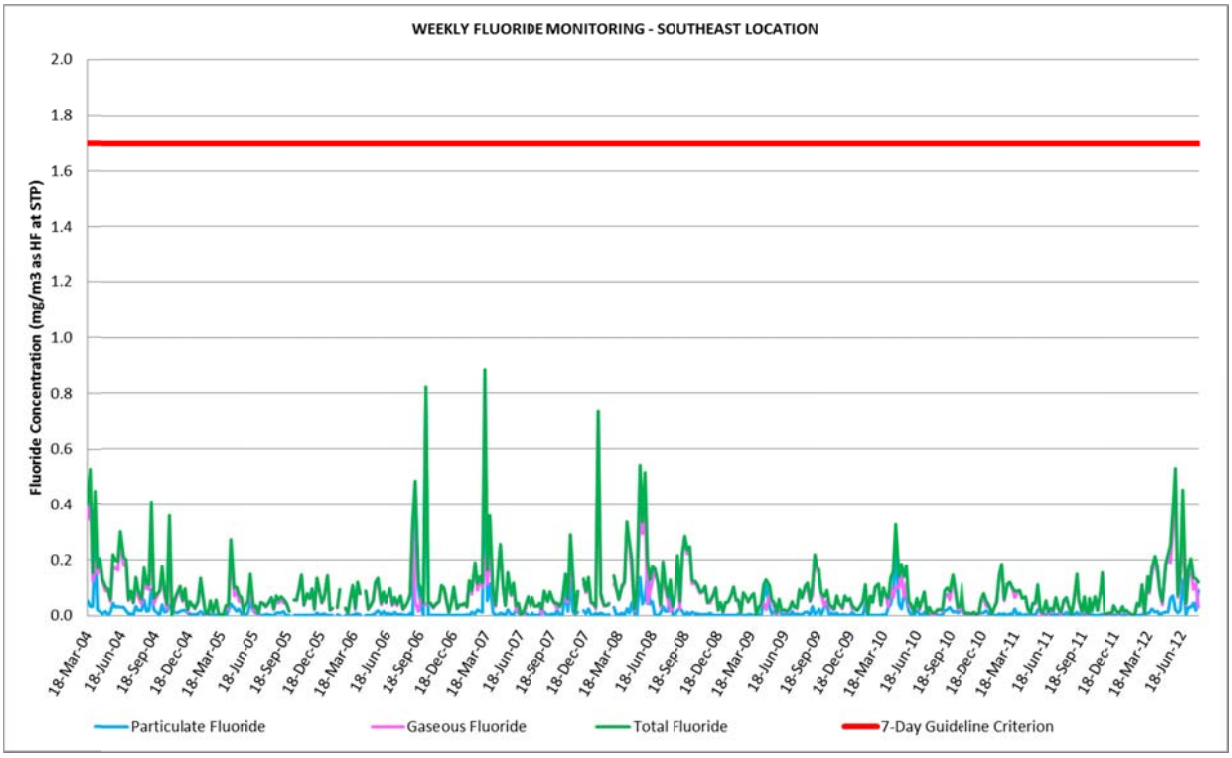

Figure 28 Weekly Fluoride Monitoring – Southeast Location 2004 - 2012

5.2 Fluoride Impact on Vegetation

The results of the quarterly vegetation reports are consistent with the outcomes predicted in the EIS. As predicted, minimal fluoride impact to vegetation in close proximity to NCIA was noted in the reporting period. Assessment of seasonal fluoride impacts on vegetation has been undertaken at NCIA since the commencement of operations in March 2004. Results of the seasonal assessment undertaken in December 2011 are given in the Annual Vegetation Condition Assessment report (**Appendix D**) and are summarised below.

5.2.1 Visual Impact on Vegetation – Trends

Table 19 summarises the seasonal variation in visible injury expression in fluoride-sensitive tree species at three locations – the NCIA monitoring site (Site 5), Gillette Close (Site 7), and Gardiner Road (Site 15), with data based on monitoring events from 2003 – 2011 where available. As a function of the variability in seasonal development, one-year old foliage was used for the comparison. The fluoride components of injury have been separated from other effects such as drought and insect injury to provide an estimate of emissions injury.

Overall, emission and total injury to foliage is relatively consistent on the long term based on data from the previous annual surveys. However, the 2011 results show a slight improvement in health condition for the three specimens studied. It is possible that the above average rainfall observed in the area in the winter and spring of 2011 have contributed to extensive foliage growth and positive tree and shrub health.

The *Eucalyptus amplifolia* at Site 5 has been suffering comparable emission related injuries over the last few years, with very slight to slight symptoms. However with only very slight impacts, insect damage was less severe in 2011 than in previous years where distinct and marked symptoms were consistent on that tree.

Between 2003 and 2006, the *Corymbia maculata* at Site 7 did not appear affected by fluoride symptoms. The health of this tree apparently started to deteriorate in 2007 and it had consistently been showing slight to distinct necrosis and chlorosis symptoms ever since. The 2011 survey revealed an improvement in the emission related injury from ‘distinctly impacted’ in the previous three years to ‘slightly impacted’.

The *Corymbia maculata* at Gardiner Road (Site 15) was in better condition than observed in the previous surveys. It exhibited only very slight symptoms of injuries whilst distinct and marked symptoms were present in the previous years.

Table 19 Annual comparison of visible injury expression in one-year-old foliage from selected tree species in the Rutherford area

Species	Date	Emissions injury	Total injury	Leaf age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction - buds	Reproduction - fruit
Site 5: NCIA air monitoring station															
Eucalyptus amplifolia	2007	2	2	0	2	0	0	0	0	2	0	0	0	✓	✓
	2008	0	5	1	0	0	0	0	3	4	2	0	0	0	0
	2009	0	4	1	0	0	0	0	3	4	2	0	0	0	0
	2010	2	3	1	0	0	2	0	3	3	0	0	0	0	0
	2011	**2**	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**2**	**1**	**0**	**0**	**0**
Site 7: Gillette Close															
Corymbia maculata	2003	0	2	1	0	0	0	0	0	2	0	0	0	0	0
	2004	0	1	1	0	0	0	0	0	1	0	0	0	0	0
	2005	0	3	1	0	0	0	0	0	3	2	0	0	0	0
	2006	0	3	1	0	0	0	0	2	3	0	0	0	0	0
	2007	0	2	1	0	0	2	0	2	2	0	0	0	0	✓
	2008	3	3	0	3	0	0	0	0	2	3	0	0	0	0
	2009	3	3	1	3	0	2	1	3	3	3	0	2	0	0
	2010	3	3	1	3	0	2	1	3	3	3	0	2	0	0
	2011	**2**	**3**	**1**	**2**	**2**	**1**	**1**	**0**	**3**	**2**	**1**	**0**	✓	**0**
Site 15: 11 Gardiner Road															
Corymbia maculata	2003	0	2	1	0	0	0	0	0	2	2	0	0	0	0
	2004	0	2	1	1	0	1	0	0	2	1	0	0	0	✓
	2005	0	3	1	0	0	0	0	0	3	2	0	0	0	0
	2006	0	3	1	0	0	2	0	3	3	0	0	0	0	✓
	2007	2	3	1	2	0	2	0	3	3	0	0	0	0	0
	2008	2	4	1	4	0	3	2	3	3	3	0	2	0	✓
	2009	3	3	1	3	2	3	0	2	3	2	0	0	0	0
	2010	3	3	1	3	2	3	0	0	3	1	0	0	0	✓
	2011	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**0**

5.2.2 Fluoride Content in Vegetation – Trends

A comparison of the historical fluoride concentrations against the fluoride concentrations obtained in the reporting period is detailed in **Table 20**. The differences in availability of foliage make direct comparisons with previous years difficult.

The native grasses at Wollombi Road and the vine leaves at Anambah Homestead both recorded fluoride content of less than 10 µg/g. This low concentration is consistent with the long term trend for these species over the last seven years.

Fluoride content in the leaves *of Eucalyptus amplifolia* at Site 5 was of 20.8 µg/g, which is in the lower range of values recorded in the previous years. In contrast, the foliage of *Eucalyptus amplifolia* located at Site 13 was more than five times as chlorotic (114 µg/g). This elevated concentration is comparable to previous years' values for this tree. Both these trees are located within close proximity of the kiln stack where atmospheric fluoride is emitted, however the marked difference in fluoride leaf content reflect the location of the trees in relation to the prevailing winds during the growing season, the specimen in the north-west (Site 13) being exposed to the winds during this season.

The *Corymbia maculata* at Site 13 has traditionally shown low levels of fluoride in its foliage, which was perpetuated this year with a concentration of 13.5 µg/g.

At Site 15, *Corymbia maculata* returned a foliage fluoride content of 48.9 µg/g which is in the lower range (yet consistent) of values observed in the last six years. Prior to that, fluoride concentration in this tree were significantly lower.

Table 20 Analytical results of fluoride content in vegetation for 2012 and previous annual surveys

Site	Species Sampled	Sample Age	Fluoride Level (µg/g)*							
			Nov 04	Feb 06	Nov 06	Feb 08	Feb 09	Jan 10	Dec 10	Dec 11
5	*Eucalyptus amplifolia*	0	-	-	-	22	-	-	31.6	-
		1	-	-	-	63	11	58.8	-	-
		Mixed	-	-	-	-	-	-	-	**20.8**
11	Native Grasses	1	<10	<1	11	7	10	10	<10	**<10**
13	*Eucalyptus amplifolia*	0	-	-	-	111	22	-	54.1	-
		1	-	-	-	132	-	150	-	-
		Mixed	-	-	-	-	-	-	-	**114**
	Corymbia maculata	0	-	-	-	33	<10	<10	<10	-
		1	-	-	-	-	-	24.6	-	-
		Mixed	-	-	-	-	-	-	-	**13.5**
15	*Corymbia maculata*	0	12	-	21	45	12	19	16.8	-
		1	-	-	40	103	73	75	-	-
		Mixed	12	2	-	-	-	-	-	**48.9**
19	*Vitis vinifera*	Mixed	<10	<1	3	6	<10	15	<10	**<10**

* µg/g are equivalent to mg/kg (as reported in the laboratory certificate of analysis)

- indicates no sample was taken

5.3 Air Pollutant Load Limits

The maximum load limits for the facility specified in the Consent and EPL and the current and historical assessable pollutant loads are shown in **Table 21**. There were no exceedances of pollutant load limits during the AEMR reporting period.

Table 21 Maximum Pollutant Load Limits and assessable pollutant loads

Pollutant	Actual Load (kg)							Current Maximum Load Limit (kg)	
	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010*	2010 - 2011	2011 - 2012	Consent	EPL
Fine particulates	25,751	7,288.7	4,449.2	5,475.6	6,524.2	2,902	997	49,609	26,629
Coarse particulates	11,986	12,657.1	3,880.8	2,564.4	475.3	1,774	5,550	26,712	14,338
Fluoride	4,085.4	1,988.6	335.9	1,528.9	621.1	295	91	3,701	1,850
Sulfur oxides	13,239.1	15,850.3	16,632.9	62,426.2	86,704	7,699	26,946	73,657	36,828
Nitrogen oxides	13,887.3	12,422.9	18,072.6	70,564.6	79,375	18,322	20,306	73,657	36,828

**2009-2010 marked the commencement of stage 2 of the development*

5.3.1 Trends

The Consent and EPL load limits were not exceeded during the AEMR reporting period. The assessable pollutant loads for the AEMR reporting period were lower than previous reporting periods for fine particulates and fluoride, while they were higher for coarse particulates, sulfur oxides and nitrogen oxides; however all were below the maximum load limit.

The assessable load for fluoride was lower than previous years, which is likely due to normal variation in stack testing as well as the maintenance and repairs undertaken in the 2009 – 2010 reporting period, including the use of a more reactive hydrated lime for fluoride emission control.

The sulfur oxide load level was higher than the 2010-2011 reporting period, but similar or lower than previous reporting periods. It was noted in the 2009 – 2010 AEMR that previous high levels of sulfur resulted from a higher than normal flow rate. The high flow rate was rectified, but the load level still exceeded the limit. Further investigation was undertaken to determine the source of the high sulfur levels. Sulfur oxide loads reported annually have previously included both sulfur trioxide and sulfur dioxide. In consultation with DoPI and OEH, as part of negotiating NCIA's draft Part 3A Project Approval conditions, it was agreed that 'Sulfur Oxides' was to be specifically defined as sulphuric acid mist and sulphur trioxide (as SO_3).

The graphs below show these trends visually (**Figure 29** to **Figure 33**).

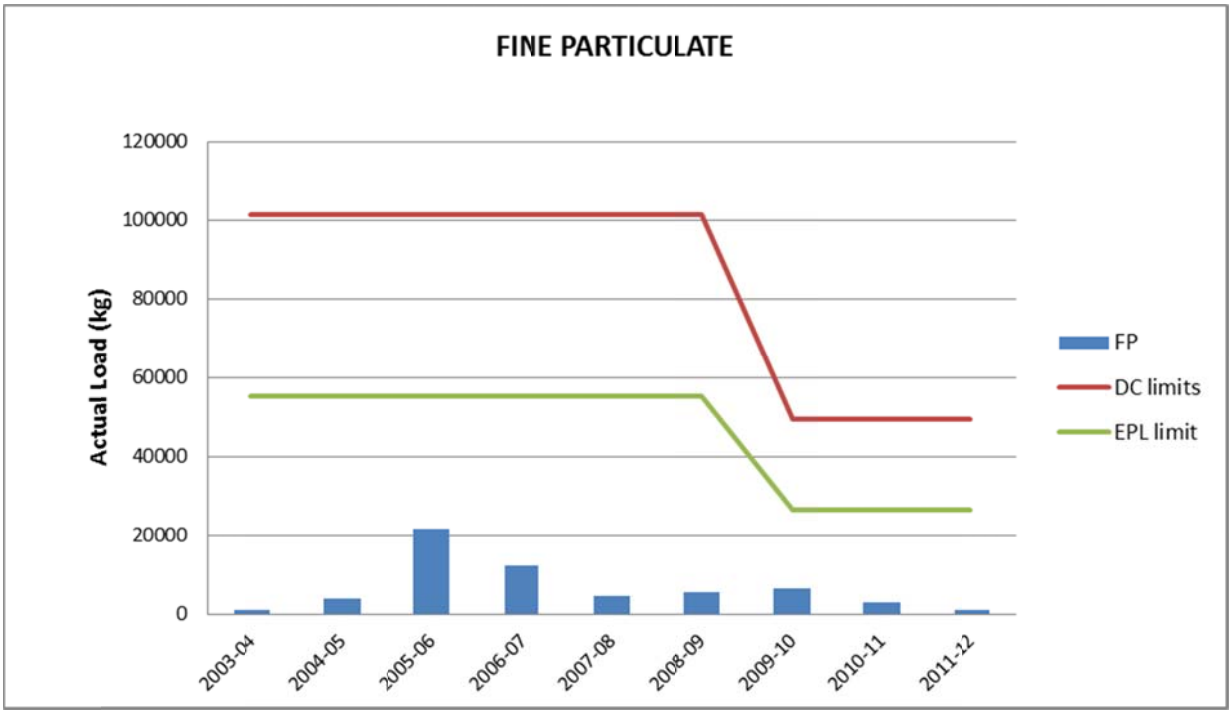

Figure 29 Fine Particulate Annual Load 2004 – 2012

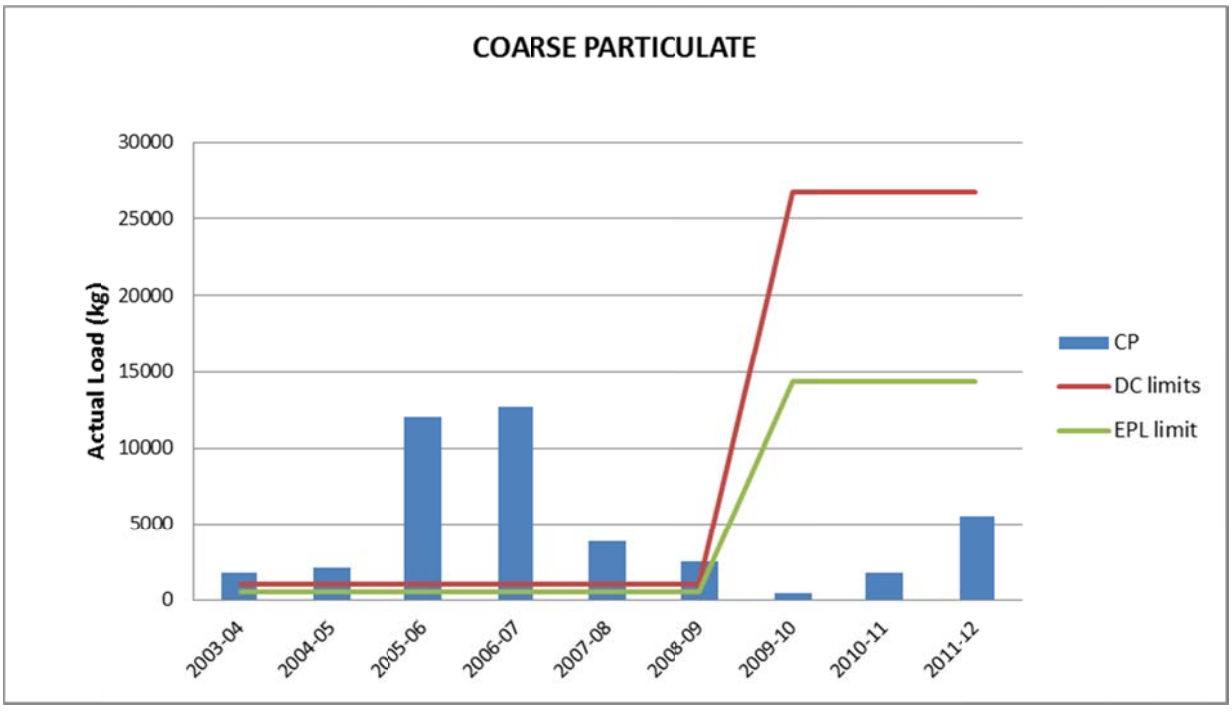

Figure 30 Coarse Particulates Annual Load 2004 – 2012

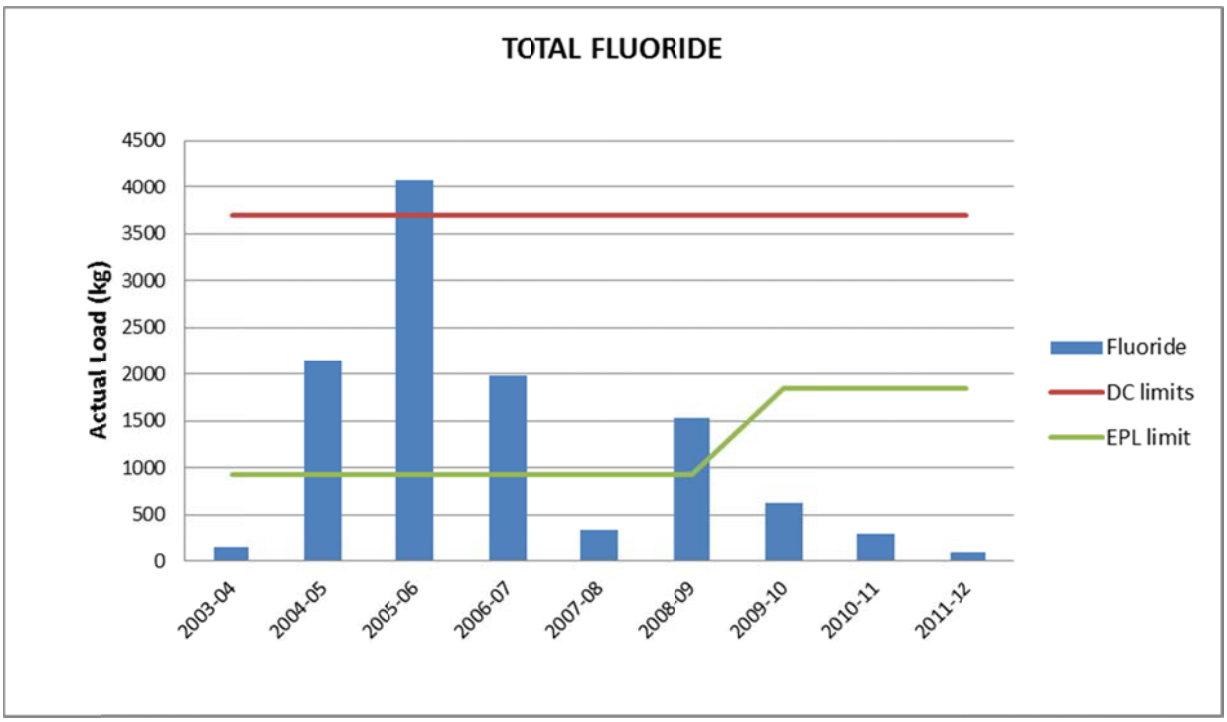

Figure 31 Fluoride Annual Load 2004 – 2012

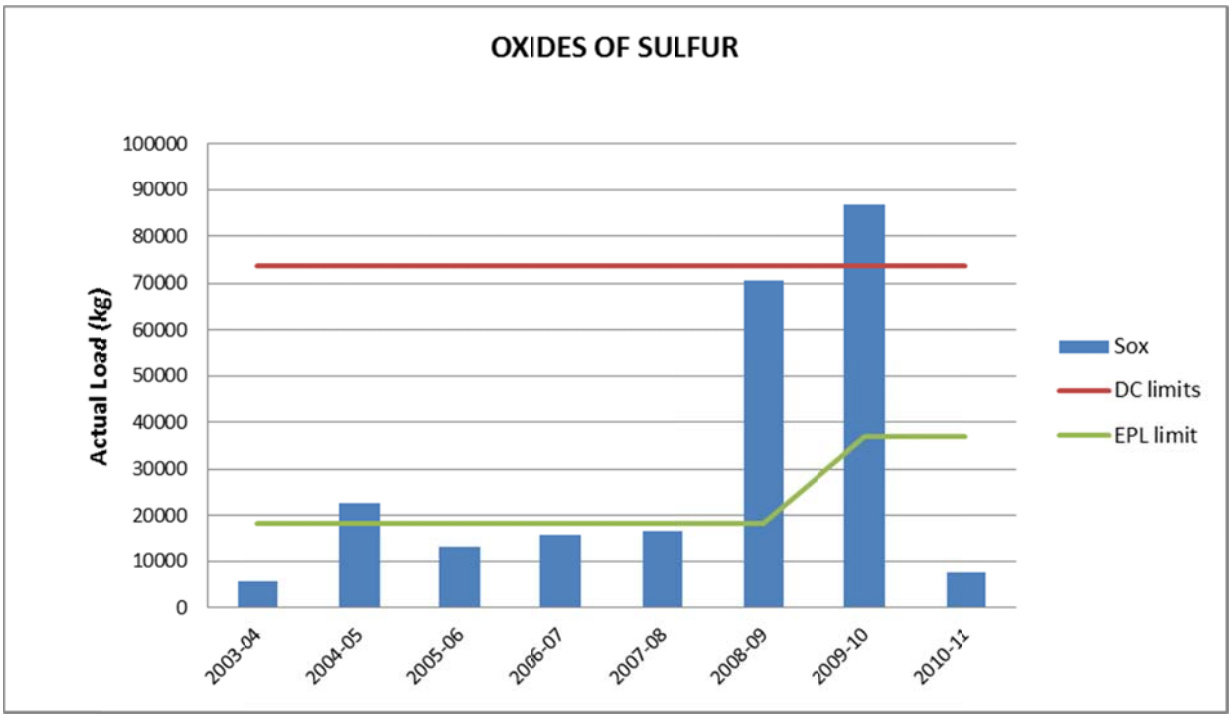

Figure 32 Sulfur Oxides Annual Load 2004 – 2012

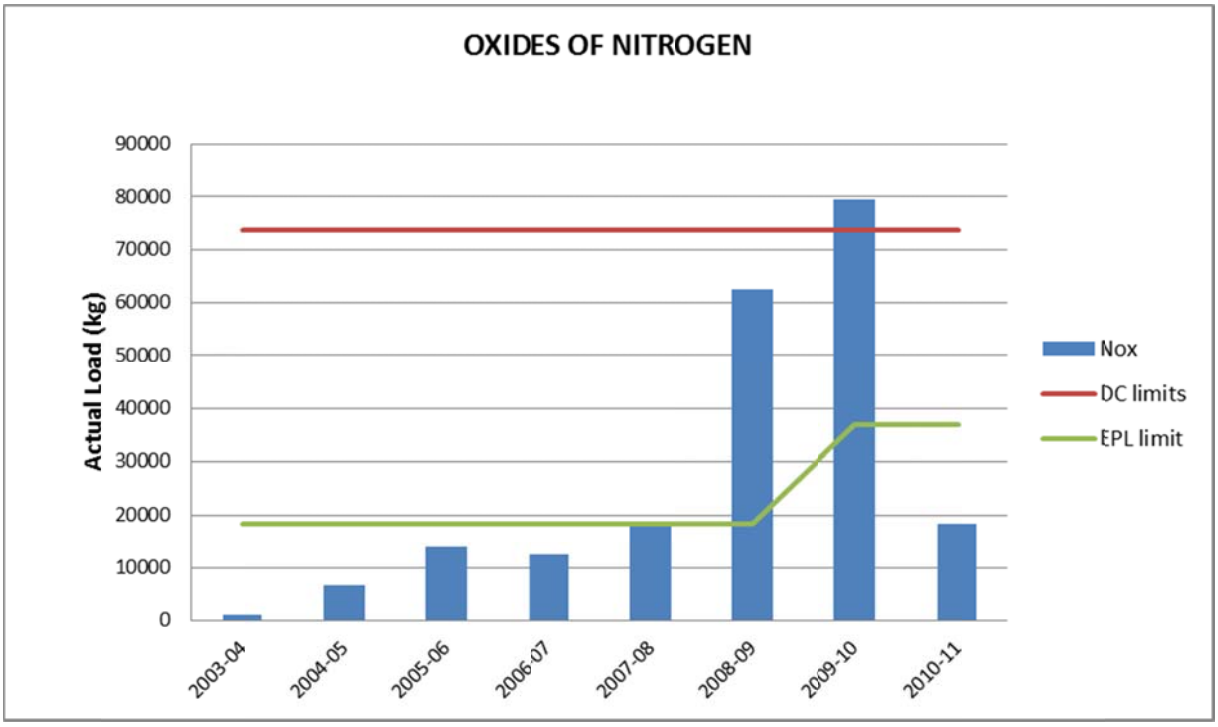

Figure 33 Nitrogen Oxides Annual Load 2004 - 2012

5.4 Noise

As per the EIS, due to the influence of other nearby facilities and other noise sources, noise levels are set to be measured at the nearest residential properties and are predicted not to exceed criterion level of 35 dBA. According to the annual noise report for the current reporting period (**Appendix F**), noise emissions from NCIA complied with the EPL day, evening and night time noise criteria.

5.4.1 Trends

Table 22 provides the estimated noise contribution from the NCIA facility at the nearest sensitive receptor from 2004 to 2012. Noise levels from the facility for the day, evening and night periods were estimated based on operator notes taken during the noise survey and free field calculations. On many occasions the NCIA facility was not clearly audible over other dominant industrial and traffic noise sources nearby.

Table 22 Noise Trends 2004 - 2012

Noise Level	$LA_{eq(15\ Minute)}$ dBA			$LA_{1(1\ Minute)}$ dBA
	Day	Evening	Night	Night
Annual Survey October 2004	48	42	45	51
Estimated NCIA Contribution	≤ 41 Not clearly audible over other noise sources.	38	35 - 36	≤ 44 (LA90)
Post Commissioning (Stage 1) Survey April 2005	49	42	46	44
Estimated NCIA Contribution	< 42 (LA90) Not audible over background noise.	< 39 (LA90) Not audible over background noise.	Not Audible 34	Not Audible < 44
Annual Survey June 2006	47	52	49	43

Noise Level	$LA_{eq(15\ Minute)}$ dBA			$LA_{1(1\ Minute)}$ dBA
	Day	Evening	Night	Night
Estimated NCIA Contribution	≤ 40(L_{A90}) Not audible over other background noise.	≤ 39 (LA90) Not clearly audible over other dominant industries.	≤ 36 Not clearly audible over other dominant industries.	≤ 43
Annual Survey March 2007	53	40	37	39
Estimated NCIA Contribution	≤ 40 Not clearly audible over other dominant noise sources.	≤ 37 (LA90) Not clearly audible over other dominant industries.	≤ 34 Not clearly audible over other dominant industries.	≤ 39
Annual Survey June 2008	48	45	40	40
Estimated NCIA Contribution	35 Not clearly audible over other dominant noise sources.	35 Not clearly audible over other dominant noise sources.	35 Not clearly audible over other dominant industries.	35 - 37
Annual Survey July 2009	44	42	40	N/A
Estimated NCIA Contribution	NCIA audible not measurable	38 Not clearly audible over other dominant noise sources.	37 Not clearly audible over other dominant noise sources.	No discernable L1 (1 min) events from NCIA during any of the measurements.
Annual Survey July 2010	47	40	38	N/A
Estimated NCIA Contribution	NCIA audible not measurable	est <30 NCIA barely audible	34	No discernable L1 (1 min) events from NCIA during any of the measurements
Annual Survey June 2011	54	49	48	N/A
Estimated NCIA Contribution	NCIA audible not measurable	33	34	No discernable L1 (1 min) events from NCIA during any of the measurements.
Annual Survey June 2012	47	51	47	N/A
Estimated NCIA Contribution	NCIA audible not measurable	NCIA audible not measurable	NCIA audible not measurable	No discernable L1 (1 min) events from NCIA during any of the measurements.
Criteria	**41**	**39**	**35**	**45**

Figure 34 – **Figure 36** show the noise levels for the day, evening and night periods from 2004 – 2012. Noise contribution from NCIA is generally compliant with the noise criteria specified in the Consent and EPL. There were no discernible LA_1 (1 Min) events from NCIA during any of the measurements of the night time period for 2009, 2010, 2011 and 2012.

As mentioned in Section 4 the NSW INP states that: *a development will be deemed to be in non-compliance with noise consent or license condition if the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence condition*. In particular, noise levels from NCIA are in compliance with the noise criteria specified in the Consent and EPL for the AEMR reporting period.

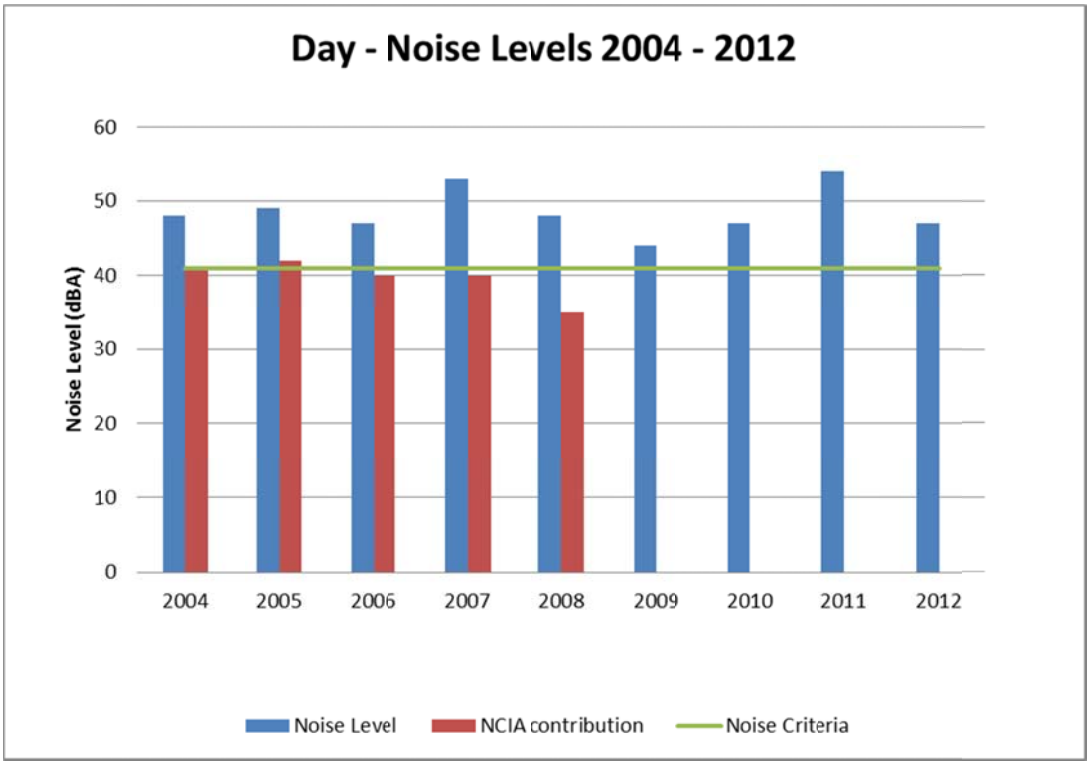

Figure 34 Day Noise Levels 2004 - 2012

Note: 2009, 2010, 2011 and 2012 – NCIA audible not measurable.

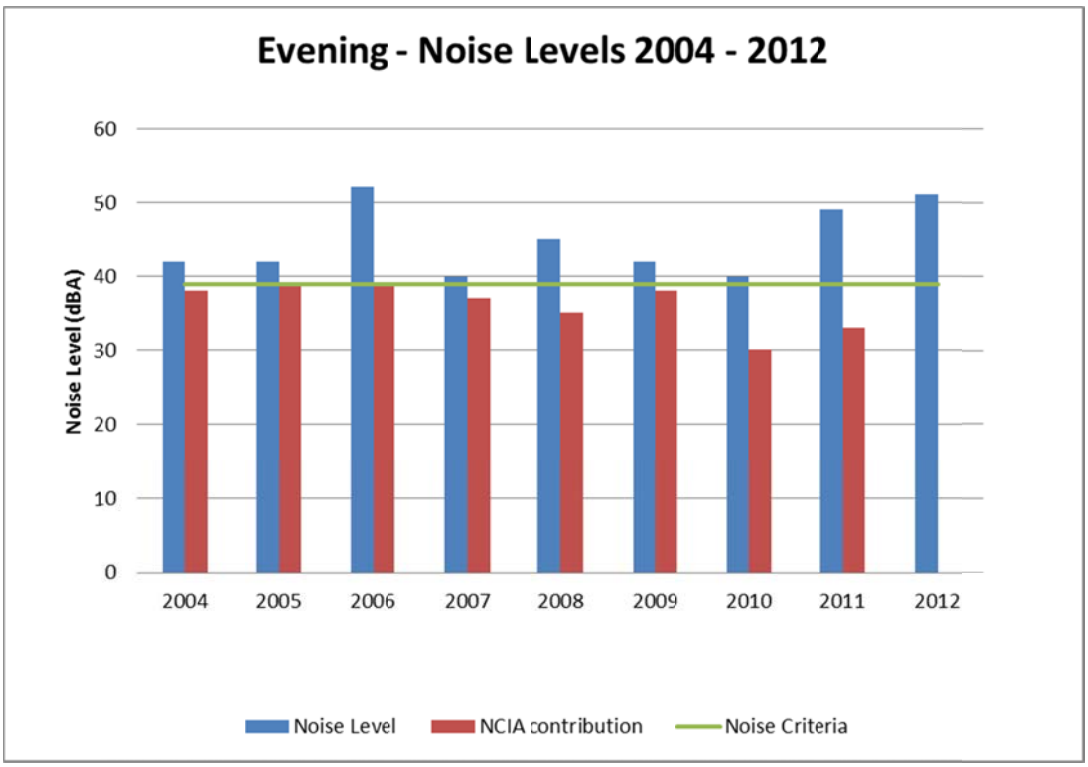

Figure 35 Evening Noise Levels 2004 – 2012

Note: 2012 – NCIA audible not measurable.

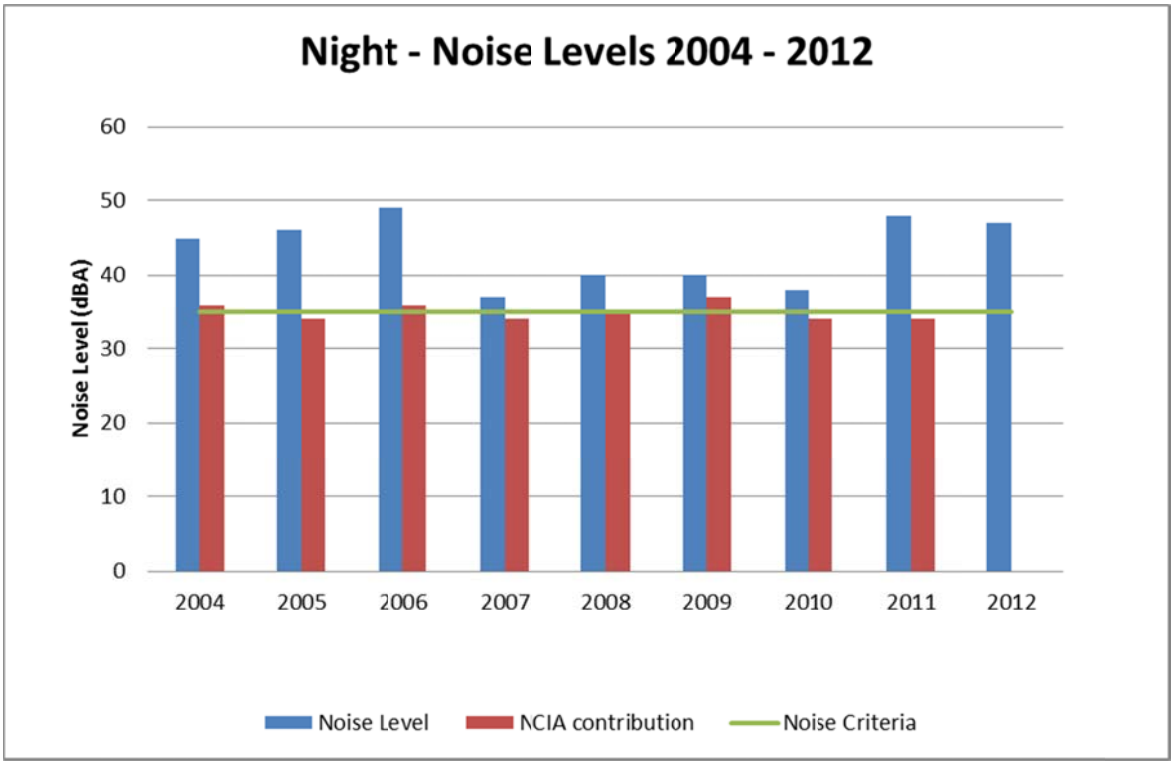

Figure 36 Night Noise Levels 2004 – 2012

Note: 2012 – NCIA audible not measurable.

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6.0 Variations to Approvals

The latest modification to NCIA's development consent occurred prior to the current reporting period (449-12-2002-I Mod 5, approved on 15 March 2011).

An application to vary NCIA's EPL was submitted to OEH under Section 58 of POEO Act 1997 to ensure consistency is maintained with development consent Mod 5. This EPL variation was approved by OEH on 7 November 2011.

It is anticipated that in early 2013 NCIA will transition over to the project approval issued under Part 3A of EP&A (application number 09_0006). As such an EPL variation may be necessary during the next reporting period to ensure the EPL is consistent with the Part 3A approval. However this would all occur during the next reporting period.

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7.0 Environmental Management Targets and Strategies

Additional environmental and community performance activities proposed for the next AEMR reporting period have been based on the areas of non-achievement of goals that were predicted in the EIS and required in regulations during this reporting period.

Emissions concentrations of all pollutants were in accordance with EPL limits and there were no exceedances of pollutant load limits. There one occasion which the scheduled 24hr ambient hydrogen fluoride sample was not collected due to a power outage. NCIA has updated its ambient sampling procedure to include a requirement for one make-up sample to be taken for each missed, scheduled sample to ensure that the required number of samples is obtained over the course of future reporting periods.

NCIA undertook preliminary discussions with AGL in regard to establishing a co-generation facility at the site during the previous reporting period; however these discussions are now on hold. Other recommended actions for the 2012-13 reporting period are summarised in **Table 23**.

Table 23 Timetable for Proposed Recommendations

Area of Concern	Identified Action	Completion Date
Baghouse equipment life time	Enclose Kiln baghouse.	Complete.
General stack maintenance	Install new components when necessary.	Ongoing.
Vegetation planting	Native vegetation planting as per the proposed landscape vegetation planting plan in the NCIA EA.	Ongoing for care and maintenance.
Consent / EPL Variation	Modify oxygen correction requirement for Kilns.	Consent modification approved 15 March 2011. Transition to the project approval issued under Part 3A of EP&A (application number 09_0006) to occur during 2013.
		EPL variation was approved by OEH on 7 Nov 2011. An EPL variation may be necessary during the next reporting period to ensure the EPL is consistent with the Part 3A approval.
Plant maintenance	General housekeeping.	Ongoing.

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Appendix A

Compliance with EPL and Development Consent

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Appendix A Compliance with EPL and Development Consent

Table A1 NCIA Compliance with EPL Requirements

EPL Requirement	Description	Timing	Compliance
Condition A1	Production of up to 200 000 tonnes per annum	Ongoing	Yes. As per NCIA production records: - 04/05 – 12 341 tonnes per annum of tiles produced. - 05/06 – 60 126 tonnes per annum of tiles produced. - 06/07 – 55 413 tonnes per annum of tiles produced. - 07/08 – 66 672 tonnes per annum of tiles produced. - 08/09 – 67 293 tonnes per annum of tiles produced. - 09/10 – 110 396 tonnes per annum of tiles produced. - 10/11 – 83,095 tonnes per annum of tiles produced. - 11/12 – 52,911 tonnes per annum of tiles produced.
Condition A3	Information supplied to the OEH	Ongoing	Yes. Activities are carried out in accordance with EPL as per Annual Return 11/12.
Condition P1	Location of monitoring/discharge points and areas	Upon construction	Yes. Emission sources/monitoring points installed and commissioned at designated locations.
Condition L2	Load limits	Ongoing	Yes - as per AEMR 11/12 Section 4 and 5.
Condition L3	Concentration limits	Ongoing	Yes - as per AEMR 11/12 Section 4 and 5.
Condition L4	No acceptance of off-site waste; disposal of on-site waste as permitted by licence. Lime scrubber waste to be assessed, classified and disposed of in accordance with OEH guidelines.	Ongoing	Yes – Specific waste immobilisation approval received from OEH, valid until 30 August 2012. Waste stored inside plant building prior to disposal. Discussions commenced with OEH to renew approval.
Condition L5	Noise Limits	Ongoing	Yes as per Annual Noise Report 11/12 by Spectrum Acoustics (**Appendix F**).
Condition L6	Potentially Offensive Odour	Ongoing	As per NCIA Air Quality management Plan (Section 5 of the OEMP).
Condition O1	Activities must be carried out in a competent manner.	Ongoing	As per Site Safety Induction, General Site Induction and NCIA Safety Management System (SMS).
Condition O2	Maintenance of plant and equipment.	Ongoing	As per NCIA procedures: Operation of Equipment and Inspection Procedures for Operational and Safety Equipment.
Condition O3	Minimisation and/or prevention of dust emissions.	Ongoing	As per NCIA Air Quality Management Plan (Section 5 of the OEMP).

EPL Requirement	Description	Timing	Compliance
Condition O4	Impact on vegetation – licensee must investigate and submit a report to the OEH identifying the magnitude of vegetation damage and the potential for fluoride emissions from the plant to have contributed to the damage.	Following complaints in relation to vegetation damage; annual and quarterly reports to be submitted to DoPI and OEH.	Yes - No complaints relating to vegetation damage have been received to date; all annual and quarterly reports have been submitted as required (AEMR 11/12 **Section 4.2 and Section 5.2** & **Appendix D**).
Condition M1	Monitoring results and sample records required by the licence must be maintained for a minimum of 4 years in a legible form.	Ongoing	Yes – all results and records are maintained by AECOM.
Condition M2	Ambient Air Monitoring: PM_{10} and Fluoride at two monitoring locations (NW and SE). Sampling methodologies, units of measure and frequency are stipulated by Licence. Reporting to OEH as part of Annual Return (annual anniversary: 1 August).	Ongoing	No - Refer to AEMR 11/12 **Section 4.1** and **Section 5.1**; and Annual Return for 11/12 (**Appendix B**).
	Emission testing; performance emission testing – sampling methodologies, units of measure and frequency as stipulated by EPL.	Annually	
Condition M3	Testing methods – concentration limits: pollutants emitted to the air.	Ongoing	Yes, refer to the NCIA Air Quality Management Plan (Section 5 of the OEMP), Annual Emission testing reports and the SOP for Ambient Air Monitoring by AECOM.
Condition M4	Fluoride vegetation impact monitoring (visual assessment and foliage assays).	Monitoring program submitted and approved by DoPI prior to commencement of Stage 1. Annual and quarterly monitoring.	Yes. Copies of annual and quarterly surveys submitted to Department of Planning and Infrastructure and NSW OEH.
Condition M5	Meteorological monitoring at representative location.	Reporting as part of Annual Return.	Yes. Refer AEMR 11/12 **Section 4.3**
Condition M6	Pollution complaints register to be maintained.	Ongoing	Yes - no complaints received during the 11/12 reporting period.
Condition M7	Telephone Complaints Line	Ongoing	Yes. Telephone number advertised and available for receipt of complaints.

EPL Requirement	Description	Timing	Compliance
Condition R1	Annual return documents.	Ongoing	Yes as per Annual Return 04/05, 05/06, 06/07, 07/08, 08/09, 09/10 and 10/11. The 11/12 Annual Return was submitted to the OEH by 30 September 2012.
Condition R2	Notification of environmental harm.	As soon as practicable; written details to OEH within 7 days of incidents.	N/A – no incidents have occurred.
Condition R3	Written Report relating to events taking place that may have caused environmental harm.	Per OEH request	N/A – no incidents have occurred.
Condition G1	Copy of licence kept at the premises.	Ongoing	Copy of current licence maintained in administration building. Copy also maintained at AECOM premises as part of the OEMP.
Condition U1.1	Post commissioning performance air quality emission testing of each stage of development.	Within 90 days of commencement of operation under design loads and normal operating conditions.	Yes, as per NCIA Dispersion Modelling and Validation Report by ENSR, dated March 2005, submitted to the OEH and DoPI in September 2005 and referred to in the 2004/05 AEMR. The Predictive Air Quality Assessment for Stage 2 was submitted to the DoPI on 19 September 2007. AECOM completed Stage 2 Air emission performance verification monitoring report and was submitted to DoPI in November 2009.

Table A2 NCIA Compliance with Development Consent (DA 449-12-2002-i) Requirements

Development Consent Requirement	Description	Timing	Compliance
Condition 1.1	Obligation to minimise harm to the environment.	Ongoing	As per NCIA Construction Environmental Management Plan (CEMP), OEMP and Weekly Site Inspection Reports.
Condition 1.2	Development carried out generally in accordance with listed documents.	Ongoing	All relevant consents have been based on the listed documents and have been obtained prior to works commencing. Works are undertaken in accordance with those consents.
Condition 1.4	Predictive Air Quality Assessment to be submitted to Director-General; feed-forward / feedback mechanism.	Prior to construction of Stages 2, 3 and 4.	Yes, a Predictive Air Quality Assessment was submitted to the DoPI on 19 September 2007. Commissioning of Stage 2 Development occurred late 2009. Predictive Air Quality Assessment for Stage 3 and 4 submitted 23 October 2009
Condition 1.5	Provision of documents.	Ongoing	Documents provided as required.
Condition 1.6	Licences, permits and approvals are obtained and kept up to date.	Notification to DOPI and OEH required (respectively) prior to construction and operation of subsequent stages.	Yes as per Stage 1 development.
Condition 1.7	Applicant to ensure all employers, contractors and sub-contractors are aware of and comply with conditions of consent.	Ongoing	As per NCIA OEMP: Section 3.1: Roles and Responsibilities, Appendix C: Task Instruction 1 – Record of Induction and Training A copy of the current EPL and Development Consent is maintained in the NCIA administration building. A copy is also maintained at AECOM premises as part of the OEMP.

Development Consent Requirement	Description	Timing	Compliance
Condition 1.8	Applicant responsible for environmental impacts resulting from actions of all people on site.	Ongoing	As per NCIA OEMP: Section 3.1: Roles and Responsibilities, Appendix C: Task Instruction 1 – Record of Induction and Training Task Instruction 2 – Control of Non-conformance/Incidents/ Complaints.
Condition 1.9	Certify by written compliance report that all conditions of consent have been complied with.	Prior to commencement of construction and operations.	Yes, as per compliance report for Stage 1 construction and operation, sent to the DoPI on 7 April 2004. Also, as per NCIA AEMR 04/05 and 05/06 (Compliance Assessment section).
Condition 1.10	Updates of compliance requested by the Director-General.	As requested by the Director-General	N/A no updates of compliance requested to date.
Condition 1.11	Requirements of the Director-General to ensure compliance with conditions of this consent, and general consistency with documents listed under condition 1.2 are met.	Ongoing	Yes. An Air Quality Mitigation Study was submitted to the OEH for review on 14 September 2007 to address consent condition 5.7. DoPI approval for the modification of the Development Consent was received. Stage 2 Air Quality Mitigation for NCIA Study was submitted to the OEH for review in June 2010
Condition 1.12	Referral of any disputes between the Applicant and Council or a public authority to the Director General.	Ongoing	N/A no disputes to date.
Condition 4.1	The Applicant must not cause or permit the emission of offensive odours from the site.	Ongoing	Yes. No complaints were received relating to offensive odours during the reporting period.
Condition 4.2	Dust emissions must be minimised.	Ongoing	Yes as per NCIA OEMP and Weekly Site Inspection Reports.
Condition 4.3	Trucks carrying loads which may generate dust are covered during movement.	Ongoing	Yes as per NCIA OEMP and Weekly Site Inspection Reports.

Development Consent Requirement	Description	Timing	Compliance
Condition 4.4	Trafficable areas and vehicle manoeuvring areas maintained to minimise dust.	Ongoing	Yes as per NCIA OEMP and Weekly Site Inspection Reports.
Condition 4.5	Discharge limits	Ongoing	Refer to EPL Condition L2 & L3
Condition 4.6	Load limits	Ongoing	Refer to EPL Condition L2 & L3
Condition 4.7	Stack Discharge Design Requirements.	During construction	N/A no stacks have been designed or constructed in the reporting period.
Condition 4.8	Buildings to be constructed in accordance with the EIS.	During construction	N/A no buildings constructed in the reporting period.
Condition 4.9	Design, construction, operation and maintenance of manufacturing facility.	Ongoing	Yes as per Annual Compliance Air Emission Reports.
Condition 4.10	Manufacturer's performance guarantees (emission concentration limits).	Prior to construction	Yes, issued prior to the construction of Stage 1, as per communication with NCIA Managing Director. Commissioning of Stage 2, 1 August 2009.
Condition 4.11	Establishment of meteorological station.	Prior to construction	Yes, maintained by AECOM.
Conditions 4.14, 4.15, 1.17, 4.17, 4.18	Noise Impacts	Ongoing	Yes as per CEMP and annual noise reports (refer to AEMR 04/05, 05/06, 06/07, 07/08, 08/09, 09/10, 10/11 and 11/12).
Condition 4.19	Compliance with s120 (pollution of waters) of the *Protection of the Environment Operations Act 1997*.	Ongoing	Yes as per EPL 11956 and EPL review of compliance above.
Condition 4.20	All erosion and sedimentation controls in place.	Prior to construction	Yes. Refer to the Water Management Plan for details of erosion and sedimentation controls.
Condition 4.21	Use of wheel-wash facility.	Construction Phase	N/A no construction activities have been undertaken in the reporting period.
Condition 4.22	Maintenance of erosion and sedimentation controls.	Ongoing	Yes as per Water Management Plan and the Landscape Management Plan, which detail erosion and sedimentation control maintenance measures.

Development Consent Requirement	Description	Timing	Compliance
Condition 4.23	Construction and operation of facility will not concentrate or lead to increase in rate of flow of stormwater over pre-development flow conditions.	Ongoing	Yes as per Water Management Plan (Section 6 of the OEMP), which details the stormwater management system.
Condition 4.24	All stormwater runoff directed to the site's stormwater detention basins. Stormwater infrastructure should be able to handle stormwater discharges up to and including a 1 in 100 year ARI storm event.	Ongoing	Yes as per Water Management Plan (Section 6 of the OEMP), which details the stormwater management system.
Condition 4.25	Creation of easements when stormwater is discharged at locations other than existing drainage lines.	Ongoing	Yes as per Water Management Plan (Section 6 of the OEMP), which details the stormwater management system.
Condition 4.26 – 4.33	Traffic & Transport Impacts – Parking.	Ongoing	Yes as per weekly site inspection, CEMP and OEMP - Section 9: Transport Code of Conduct.
Condition 4.34 – 4.43	Access & Internal Roadworks – construction.	Construction Phase	N/A no construction activities associated with access and internal roadworks has been undertaken in the reporting period.
Condition 4.44	Installation and maintenance of toilet facilities.	Construction Phase	N/A no construction activities have been undertaken in the reporting period.
Condition 4.45	Generation of building waste	Post Construction	N/A no construction activities have been undertaken in the reporting period.
Condition 4.46	Provision of designated area for the storage and collection of waste and recyclables.	Ongoing	Yes as per weekly site inspection report.
Condition 4.47	Receiving waste generated outside the site, and onsite disposal of waste generated at the site.	Ongoing	Refer to EPL Review, Condition 4.
Condition 4.49	Proper storage and handling of all dangerous goods and combustible liquids.	Ongoing	Yes as per OEMP *Appendix G: Safety Management System: Section 4* and weekly site inspection report.
Conditions 4.52, 4.53, 4.54 & 4.55	Landscaping, tree clearance and weed management.	Ongoing	Yes. Refer to Landscape Management Plan.

Development Consent Requirement	Description	Timing	Compliance
Condition 5.1	The result of monitoring required under this consent fulfils the conditions listed under Consent Condition 5.1.	Ongoing	Refer to EPL Review, Condition M1.
Condition 5.2	Ambient Air Monitoring: PM_{10} and Fluoride at two monitoring locations (NW and SE). Sampling methodologies, units of measure and frequency are stipulated by Licence. Reporting to OEH as part of Annual Return (annual anniversary: 1 August).	Ongoing	Refer to EPL Review, Condition M2.
Condition 5.3	Emission testing; performance emission testing – sampling methodologies, units of measure and frequency as stipulated by EPL.	Annually	Refer to EPL Review, Condition M2
Condition 5.4	Determination of discharge point sampling positions in accordance with TM-1.	Annually	Refer to EPL Review, Condition P1
Condition 5.5	Approval from Director-General required to alter frequency of any pollutant concentration or emission parameter.	As required	N/A
Condition 5.6	Post commissioning air quality performance emission testing of each stage of development.	Within 90 days of commencement of operation under design loads and normal operating conditions.	Yes, as per NCIA Dispersion Modelling and Validation Report (Stage 1) by ENSR (now AECOM), dated March 2005, submitted to the OEH and DoPI in September 2005 and referred to in the 2004/05 AEMR. The PAQA for Stage 2 was submitted to the DoPI on 19 September 2007. AECOM completed Stage 2 Air emission performance verification monitoring report which was submitted to DoPI in November 2009.
	Dispersion modelling for all air pollutants identified in condition 5.2 to be undertaken to confirm the air emission performance of the facility. For stages 2, 3 and 4, NCIA is to confirm the results of the predictive air quality assessment (PAQA) undertaken to satisfy condition 1.4 of the consent, and evaluate the effectiveness of any additional mitigation measures applied to satisfy that condition.	Report providing the results of the program and dispersion modelling to be submitted to the Director-General and the OEH within 28 days of completion of the required testing.	
Condition 5.7	Air quality mitigation study may be required depending on outcome of dispersion modelling – to include a timetable for implementation of the study recommendations and evidence that the OEH is satisfied with the remedial measures proposed.	If required, report due within 60 days of study completion.	The Air Quality Mitigation Study was submitted to the OEH for review on 14 September 2007. Stage 2 Air Quality Mitigation for NCIA Study was submitted to the OEH for review in June 2010

Development Consent Requirement	Description	Timing	Compliance
Condition 5.8	Fluoride vegetation impact monitoring (visual assessment and foliage assays).	Monitoring program submitted and approved by DIPNR prior to commencement of Stage 1. Annual and quarterly monitoring.	Yes. Copies of annual and quarterly surveys submitted to DoPI and NSW OEH.
Condition 5.9	Meteorological monitoring at representative location.	Reporting as part of Annual Return.	Refer to EPL Review, Condition M5.
Condition 5.10	Post-commissioning noise assessment under design loads and normal operating conditions.	Within 90 days of commencement of operation of each stage.	Refer to EPL Review, Condition U1.1.
Condition 5.12	Environmental auditing	Within 3 years of commencement of Stage 1 operations and every 3 years thereafter. Audit report to be submitted within 1 month of completion.	Audit waiting on feedback from DoPI.
Condition 6.3	Complaints register to be maintained.	Ongoing	As per NCIA Complaints Register
Conditions 7.1 and 7.2	Preparation of a Construction Environmental Management Plan.	Prior to commencement of Stage 1 construction.	Yes. As per NCIA CEMP – July 2003.
Condition 7.3 and 7.4	Preparation of an Operational Environmental Management Plan.	Prior to commencement of Stage 1 operation.	Yes. As per NCIA OEMP – January 2004. OEMP reviewed, updated and submitted to DoPI, OEH and Maitland Council on 29 June 2011.
Conditions 8.1 and 8.2	Notification of environmental incidents; and meeting of the Director-General's requirements to address the cause or impacts of any incidents.	Written reports to OEH within 7 days of incidents; as soon as practicable.	N/A – no incidents occurred in the reporting period.
Condition 8.3	Preparation of Annual Returns	Annually	Yes as per 04/05, 05/06, 06/07, 07/08, 08/09, 09/10, 10/11 and 11/12 Annual Return documents.

Development Consent Requirement	Description	Timing	Compliance
Conditions 8.4 and 8.5	Preparation of AEMRs	First AEMR due after 12 months of operation; second and subsequent to be submitted with Annual Return.	Yes – As per AEMR 04/05 (submitted in August 2006). However 2009-10 Annual Return submitted September and 2009-10 AEMR submitted October.
Condition 8.6	Requirement to address issues arising from the Director-General's review of the Annual Environmental Report and comments received from the EPA and/or Council.	As per Director-General's requirements.	Yes

Appendix B

2011 - 2012 Annual Return

Appendix B 2011 - 2012 Annual Return

Our Reference: Licence No. 11956

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

PO BOX 765

MAITLAND NSW 2320

01-Aug-2012

LICENCE ANNIVERSARY NOTICE

I refer to Environment Protection Licence No. 11956, issued to NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD by the Environment Protection Authority (EPA), under the *Protection of the Environment Operations Act 1997*.

This letter is to remind you of the annual licensing obligations, in particular the requirement to submit an Annual Return and annual licence fees.

Please find attached a customised Annual Return form that covers the period 01-Aug-2011 to 31-Jul-2012. The Annual Return is a declaration where you advise the EPA whether you complied or did not comply with the requirements of your licence. Where monitoring is required by your licence, you must enter a summary of the results in the Annual Return, using the table(s) provided. Please refer to http://www.epa.nsw.gov.au/licensing for guidance on completing annual returns.

The completed Annual Return must be submitted to the EPA by 30-Sep-2012

An Annual Licence Tax Invoice/Statement indicating the licence administrative fee is attached, please note that this fee must be submitted to the EPA by 30-Sep-2012. The licence administrative fee is based on the highest applicable administrative fee relevant to your Activity Type(s) minus any relevant credits that may be in your account. If your activity type or scale has changed you must apply for a variation of your licence using the form located at http://www.epa.nsw.gov.au/licensing/licenceforms.htm.

If the activities authorised by the licence are subject to Load-Based Licensing (LBL), payment of a load-based fee may also be required. Section A in the Annual Return will indicate whether the licensed activities have assessable pollutants. If this is the case, LBL applies to the licence. The load-based fees are calculated using the worksheets found in section D of the Annual Return. We do not need to see the load calculation workings, only the final load figures. However, you are required to keep records of the load calculations for auditing by the EPA.

If your licence is subject to load-based licence fees, there is an LBL Load Calculation Protocol that sets out the methods that may be used to calculate your emissions of assessable pollutants. The LBL Load Calculation Protocol is located at http://www.epa.nsw.gov.au/licensing/lblprotocol/index.htm.

It is important to note that the load based fee must not be paid at this time. A separate invoice for the load based fee will be issued once the EPA receives the Annual Return and load data. This load based fee must be submitted to the EPA **90 days after 31-Jul-2012**.

You are reminded that it is a condition of Licence No. 11956 that the Annual Return is submitted by the due date. It is an offence to:

- fail to complete the Annual Return;
- fail to return the Annual Return by the due date;
- provide false or misleading information in the Annual Return; or
- fail to provide monitoring data if required by a condition of your licence.

Failure to return your Annual Return by 30-Sep-2012 may result in the issue of a Penalty Notice with a penalty payable of $750 (individual) or $1500 (corporation), or prosecution.

If the licence fee is not paid by 30-Sep-2012, a penalty will be imposed in accordance with section 57 (4) of the *Protection of the Environment Operations Act 1997*. The penalty is 5% of the outstanding amount and will continue to accrue at the rate of 5% simple interest every two weeks until the outstanding amount and penalty is paid in full. In accordance with section 79 of the *Protection of the Environment Operations Act 1997* the EPA may suspend or revoke the licence if the outstanding licence fee is not paid in full by the due date.

The Annual Return and fees must be sent to the following address:

Regulatory and Compliance Support Unit
Environment Protection Authority
PO Box A290
SYDNEY SOUTH NSW 1232

We are committed to assisting the licensed community to meet its obligations under the *Protection of the Environment Operations Act 1997*. If you have any questions relating to payment and calculation of fees or the submission of the Annual Return, please contact the EPA on 02 9995 5700.

Yours sincerely

CHRISTOPHER KELLY
Head Regulatory and Compliance Support Unit
Environment Protection Authority

ANNUAL RETURN

LICENCE NO	**11956**
LICENCE HOLDER	NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD
REPORTING PERIOD	01-Aug-2011 to 31-Jul-2012

If your licence has been transferred, suspended, surrendered or revoked by the EPA during this reporting period, cross out the dates above and specify the new dates to which this Annual Return relates below:

REVISED REPORTING PERIOD _____ / _____ / _____ **to** _____ / _____ / _____

(Note: the revised reporting period also needs to be entered in Section E)

THIS ANNUAL RETURN MUST BE RECEIVED BY THE EPA BEFORE 30-Sep-2012

Your Annual Return must be completed, including certification in Section E, and submitted to the EPA no later than 60 Days after the end of the reporting period for your licence.

Failure to submit this Annual Return within 60 days after the reporting period ends may result in:

- **the issue of a Penalty Notice for $750 (individuals) or $1500 (corporations);**

OR

- **prosecution.**

Please send your completed Annual Return by **Registered Post** to:

Regulatory and Compliance Support Unit
Environment Protection Authority
PO Box A290
SYDNEY SOUTH NSW 1232

It is an offence to supply any information in this form to the EPA that is false or misleading in a material respect, or to certify a statement that is false or misleading in a material respect.

THERE IS A MAXIMUM PENALTY OF $250,000 FOR A CORPORATION OR $120,000 FOR AN INDIVIDUAL.

Details provided in this Annual Return will be available on the EPA's Public Register in accordance with section 308 of the *Protection of the Environment Operations Act 1997.*

Annual Return

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

Use the checklist below to ensure that you have completed your Annual Return correctly.
(✓ the boxes)

CHECKLIST		
☒	Section A:	All licence details are correct
☒	Section B1:	You have entered the correct number in the complaints table
☒	Section B2 – B3:	If there are tables, you have provided the required details
☒	Section C:	You have answered question 1, and 2 if applicable
☒	Section D:	If applicable, you have completed all load calculation worksheets
☒	Section E:	The Annual Return has been signed by appropriate person(s) and, if applicable, the revised reporting period entered
☒	Make a copy of the completed Annual Return and keep it with your licence records	
☐	Attach a cheque (unless you have paid separately) for the payment of the administrative fee for the next licence fee period	

Please send your completed Annual Return by **Registered Post** to:

Regulatory and Compliance Support Unit
Environment Protection Authority
PO Box A290
SYDNEY SOUTH NSW 1232

Annual Return

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

A Statement of Compliance - Licence Details

ALL licence holders must check that the licence details in Section A are correct

If there are changes to any of these details**you must advise the EPA and apply as soon as possible for a variation to your licence or for a licence transfer.**

Licence variation and transfer application forms are available on the EPA website at: http://www.epa.nsw.gov.au/licensing, or from regional offices of the EPA, or by contacting us on telephone 02 9995 5700.

If you are applying to vary or transfer your licence you must still complete this Annual Return.

A1 Licence Holder

Licence Number	11956
Licence Holder	NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD
Trading Name *(if applicable)*	
ABN	83 100 467 267

A2 Premises to which Licence Applies (if applicable)

Common Name (if any)	NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD
Premises	RACECOURSE ROAD RUTHERFORD NSW 2320

A3 Activities to which Licence Applies

Ceramic Works

A4 Other Activities (if applicable)

A5 Fee-Based Activity Classifications

Note that the fee based activity classification is used to calculate the administrative fee.

Fee-based activity	Activity scale	Unit of measure
Ceramics production	> 50,000.00 - 200,000.00	T produced

A6 Assessable Pollutants (if applicable)

Note that the identification of assessable pollutants is used to calculate the **load-based fee.**
The following assessable pollutants are identified for the fee-based activity classifications in the licence:

Ceramics production

Coarse Particulates (Air)
Fine Particulates (Air)
Fluoride (Air)
Nitrogen Oxides (Air)
Sulfur Oxides (Air)

B Monitoring and Complaints Summary

B1 Number of Pollution Complaints

Number of complaints recorded by the licensee during the reporting period. **If no complaints were received enter nil in the attached box, otherwise complete the table below.**	NIL

Pollution Complaint Category	Number of Complaints
Air	
Water	
Noise	
Waste	
Other	

B2 Concentration Monitoring Summary

For each monitoring point identified in your licence complete all the details for each pollutant listed in the tables provided below.

If concentration monitoring is **not** required by your licence, **no tables** will appear below.
Note that this does not exclude the need to conduct appropriate concentration monitoring of assessable pollutants as required by load-based licensing (if applicable).

Discharge & Monitoring Point 1

Discharge to Air, Dust extractor clay preparation CP1 & CP 2 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-

Moisture content	percent	1	1	-	5.3	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.8	-
Solid Particles	milligrams per cubic metre	1	1	-	1.7	-
Temperature	degrees Celsius	1	1	-	24.8	-
Velocity	metres per second	1	1	-	14	-
Volumetric flowrate	cubic metres per second	1	1	-	9.5	-

Discharge & Monitoring Point 3

Discharge to air, Pressing and Drying PD1 & PD2 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	1.4	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.8	-
Solid Particles	milligrams per cubic metre	1	1	-	8.6	-
Temperature	degrees Celsius	1	1	-	25.8	-
Velocity	metres per second	1	1	-	14	-
Volumetric flowrate	cubic metres per second	1	1	-	9.8	-

Discharge & Monitoring Point 5

Discharge to air, Drier D1 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	5.1	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.9	-
Solid Particles	milligrams per cubic metre	1	1	-	2.4	-
Temperature	degrees Celsius	1	1	-	108.4	-
Velocity	metres per second	1	1	-	9.9	-
Volumetric flowrate	cubic metres per second	1	1	-	1.3	-

Discharge & Monitoring Point 6

Discharge to air, Drier D2 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	4.4	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.9	-

Solid Particles	milligrams per cubic metre	1	1	-	0.82	-
Temperature	degrees Celsius	1	1	-	112.2	-
Velocity	metres per second	1	1	-	10	-
Volumetric flowrate	cubic metres per second	1	1	-	1.3	-

Discharge & Monitoring Point 9

Discharge to air, Glaze line as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	1.2	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.8	-
Solid Particles	milligrams per cubic metre	1	1	-	< 0.22	-
Temperature	degrees Celsius	1	1	-	26.0	-
Velocity	metres per second	1	1	-	14	-
Volumetric flowrate	cubic metres per second	1	1	-	10	-

Discharge & Monitoring Point 10

Discharge to air, Selection SL 1234 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	1.8	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.8	-
Solid Particles	milligrams per cubic metre	1	1	-	0.19	-
Temperature	degrees Celsius	1	1	-	27.8	-
Velocity	metres per second	1	1	-	5.9	-
Volumetric flowrate	cubic metres per second	1	1	-	1.0	-

Discharge & Monitoring Point 12

Discharge to air, Spray Drier SD1 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	16.0	-
Molecular weight of stack gases	grams per gram mole	1	1	-	29.0	-
Solid Particles	milligrams per cubic metre	1	1	-	7.9	-

Temperature	degrees Celsius	1	1	-	101.3	-
Velocity	metres per second	1	1	-	22	-
Volumetric flowrate	cubic metres per second	1	1	-	20	-

Discharge & Monitoring Point 14

Discharge to air, Kiln KP1 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Cadmium	milligrams per cubic metre	1	1	-	0.0042	-
Carbon dioxide	percent	1	1	-	1.9	-
Dry gas density	kilograms per cubic metre	1	3	1.29	1.30	1.30
Hazardous substances	milligrams per cubic metre	1	1	-	0.12	-
Hydrogen fluoride	milligrams per cubic metre	1	1	-	0.58	-
Mercury	milligrams per cubic metre	1	1	-	0.0069	-
Moisture	percent	1	3	3.8	4.6	5.0
Molecular weight of stack gases	grams per gram mole	1	3	29	29	29
Nitrogen Oxides	milligrams per cubic metre	1	1	-	68	-
Oxygen (O2)	percent	1	1	-	17.9	-

Solid Particles	milligrams per cubic metre	1	1	-	< 0.1	-
Sulfuric acid mist and sulfur trioxide (as SO3)	milligrams per cubic metre	1	1	-	82.7	-
Velocity	metres per second	1	3	14	16	17
Volumetric flowrate	cubic metres per second	1	3	4.7	5.2	5.5

Discharge & Monitoring Point 15

Discharge to air, Kiln KP2 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Cadmium	milligrams per cubic metre	1	1	-	0.0013	-
Carbon dioxide	percent	1	1	-	2.0	-
Dry gas density	kilograms per cubic metre	1	2	1.30	1.32	1.33
Hazardous substances	milligrams per cubic metre	1	1	-	0.1	-
Hydrogen fluoride	milligrams per cubic metre	1	1	-	0.19	-
Mercury	milligrams per cubic metre	1	1	-	0.0062	-
Moisture	percent	1	2	6.5	6.6	6.8
Molecular weight of stack gases	grams per gram mole	1	2	29.4	29.6	29.7
Nitrogen Oxides	milligrams per cubic metre	1	1	-	69	-

Oxygen (O2)	percent	1	1	-	17.4	-
Solid Particles	milligrams per cubic metre	1	1	-	0.044	-
Sulfuric acid mist and sulfur trioxide (as SO3)	milligrams per cubic metre	1	1	-	99.7	-
Velocity	metres per second	1	2	6.9	11	15
Volumetric flowrate	cubic metres per second	1	2	2.5	3.8	5.0

Discharge & Monitoring Point 18

Discharge to air, Hot air cooling HAC1 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	1.6	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.8	-
Solid Particles	milligrams per cubic metre	1	1	-	2.7	-
Temperature	degrees Celsius	1	1	-	67.8	-
Velocity	metres per second	1	1	-	28	-
Volumetric flowrate	cubic metres per second	1	1	-	17	-

Discharge & Monitoring Point 19

Discharge to air, Hot air cooling HAC2 as shown on Figure Titled: Plant Emission Locations and Air Quality Controls dated 17 July 2003.

Pollutant	Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Dry gas density	kilograms per cubic metre	1	1	-	1.29	-
Moisture content	percent	1	1	-	4.2	-
Molecular weight of stack gases	grams per gram mole	1	1	-	28.8	-
Solid Particles	milligrams per cubic metre	1	1	-	< 0.83	-
Temperature	degrees Celsius	1	1	-	80.4	-
Velocity	metres per second	1	1	-	18	-
Volumetric flowrate	cubic metres per second	1	1	-	15	-

Monitoring Point 22

Ambient Air Monitoring - PM 10, PM 10 monitoring locations as shown on diagram titled "Proposed ambient air quality monitoring sites - PM 10, HF and meteorological monitoring". Dated 20 January 2004

Pollutant		Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
PM10	NW	micrograms	61	61	11.8	24.6	71.9
	SE	per cubic metre	61	61	6.4	17.4	35.2

Monitoring Point 23

Ambient Air Monitoring - Fluoride compounds, HF monitoring locations as shown on diagram titled "Proposed ambient air quality monitoring sites - PM 10, HF and meteorological monitoring". Dated 20 January 2004.

Pollutant		Unit of measure	No. of samples required by licence	No. of samples you collected and analysed	Lowest sample value	Mean of sample	Highest sample value
Hydrogen fluoride 24 Hr	NW	micrograms per cubic metre	61	60	0.051	0.185	0.855
	SE		61	61	0.062	0.380	2.273
Hydrogen fluoride Weekly	NW	micrograms per cubic metre	52	52	0.006	0.113	0.752
Hydrogen fluoride Weekly	SE	micrograms per cubic metre	52	52	0.003	0.097	0.528

B3 Volume or Mass Monitoring Summary

For each monitoring point identified in your licence complete the details of the volume or mass monitoring indicated in the tables provided below.

If volume or mass monitoring is not required by your licence, **no tables** will appear below.

Note that this does not exclude the need to conduct appropriate concentration monitoring of assessable pollutants as required by load-based licensing (if applicable).

C Statement of Compliance - Licence Conditions

C1 Compliance with Licence Conditions

(☑ the boxes)

1	Were all conditions of the licence complied with (including monitoring and reporting requirements)? (✓ a box)	☐ Yes	☒ No

2 If you answered 'No' to question 1, please supply the following details for each non-compliance in the format, or similar format, provided on the following page.

Please use a separate page for each licence condition that has not been complied with.

a) What was the specific licence condition that was not complied with?

b) What were the particulars of the non-compliance?

c) What were the date(s) when the non-compliance occurred, if applicable?

d) If relevant, what was the precise location where the non-compliance occurred?

Attach a map or diagram to the Statement to show the precise location.

e) What were the registration numbers of any vehicles or the chassis number of any mobile plant involved in the non-compliance?

f) What was the cause of the non-compliance?

g) What action has been, or will be, taken to mitigate any adverse effects of the non-compliance?

h) What action has been, or will be, taken to prevent a recurrence of the non-compliance?

3. How many pages have you attached?

Each attached page must be initialled by the person(s) who signs Section E of this Annual Return

0

C2 Details of Non-Compliance with Licence

Licence condition number not complied with
M 2.1
Summary of particulars of the non-compliance (NO MORE THAN 50 WORDS)
In one Instance, scheduled 24hr ambient Hydrogen fluoride sample was not collected.
If required, further details on particulars of non-compliance
Date(s) when the non-compliance occurred, if applicable
Hydrogen fluoride sample from NW during January 2012.
If relevant, precise location where the non-compliance occurred (attach a map or diagram)
Northwest(NW) ambient air quality monitoring site, as shown on diagram entitled "proposed ambient quality monitoring sites - PM10, HF and meteorological monitoring" dated 20 January 2004. NW coordinates: 359837mE, 6378806mN (Map Datum: WGS84).
If applicable, registration numbers of any vehicles or the chassis number of any mobile plant involved in the non-compliance
N/A
Cause of non-compliance
One 24hr Hydrogen fluoride sample from the NW location was missed due to power outage and additional make-up sample not collected.
Action taken or that will be taken to mitigate any adverse effects of the non-compliance
Faulty equipment was repaired as soon as possible after errors were discovered.
Action taken or that will be taken to prevent a recurrence of the non-compliance
The ambient air sampling procedure has been updated in 2011 to include a requirement for one make-up sample to be taken for each missed, scheduled sample so that the required numbers of samples are obtained over the course of the year.

D Statement of Compliance - Load-Based Fee Calculation Worksheets

If you are **not** required to monitor assessable pollutants by your licence, **no worksheets** will appear below. Please go to Section E.

If assessable pollutants have been identified on your licence (see licence condition L2), complete the following worksheets for each assessable pollutant to determine your load-based fee for the licence fee period to which this Annual Return relates.

Loads of assessable pollutants must be calculated using any of the methods provided in the EPA's Load Calculation Protocol for the relevant activity. A Load Calculation Protocol would have been sent to you with your licence. If you require additional copies you can download the Protocol from the EPA's website or you can contact us on telephone 02 9995 5700.

You are required to keep all records used to calculate licence fees for four years after the licence fee was paid or became payable, whichever is the later date.

PENALTIES APPLY FOR SUPPLYING FALSE OR MISLEADING INFORMATION

Reporting loads of NOx (summer) and VOCs (summer) in the Sydney Basin

From 1 July 2007, all licensees in the Sydney Basin that have NOx and/or VOCs as an assessable pollutant must **also** report loads of these pollutants discharged over the summer period (December, January, February).

NOx and VOCs loads discharged over the relevant reporting period (e.g. 12 months) must be reported.

In addition, NOx (summer) and VOCs (summer) and Actual Quantity (summer) must be reported in the appropriate Load-Based Fee Calculation Worksheet to determine any fees payable.

Example: Fee Based Activity [17] Paint Production

Pollutant	Actual Quantity (T produced)	Fee Rate Threshold	Assessable load (kg)	Pollutant Weighting	Critical Zone weighting	Pollutant Fee
Benzene	16,400	3,832	1,800	740	1	$4,895
NOx	**16,400**	**42,573**	**12,440**	**9**	**7**	**$2,880**
NOx (summer)	**4,100**	**42,573**	**3,110**	**9**	**28**	**$2,880**
PM10	16,400	70,955	3,241	125	1	$1,489
VOCs	**16,400**	**123,887**	**88,000**	**6.6**	**7**	**$14,941**
VOCs (summer)	**3,500**	**123,887**	**22,000**	**6.6**	**28**	**$14,941**
					Total	$42,026

Annual Return

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

Coarse Particulates discharged to Air

D1 Pollutant Load

	actual load (kg)	weight load (kg)	'agreed' load (kg)
Ceramics production	5,550		

Actual Load

If applicable, the method used to calculate the **actual load** was:
(Method Numbers must be as per the NSW EPA's publication "Approved Methods for the Sampling and Analysis and Analysis of Air/Water Pollutants in NSW" referred to in the "Load Calculation Protocol".)

Ceramics production

- [x] Source Monitoring (SM) — Type of SM: PM; Method Number: TM15
- [ ] Emission Factors (EF) — Type of EF:
- [ ] Mass Balance (MB)
- [ ] Other EPA Approved Method

Has the calculation method of the actual load resulted in an underestimation of the amount of the assessable pollutant discharged?

- [ ] Yes
- [ ] No

Weight Load

If applicable, the **load weighting** measure used was:

Ceramics production

- [ ] Effluent re-use on site
- [ ] Effluent transfer beyond the licensed premises — If so, where to?
- [ ] Flow optimised discharge

Agreed Load

If applicable, the **agreed load** used was agreed under:

Ceramics production

- [ ] Load Reduction Agreement
- [ ] Bubble Licence Arrangement

D2 Assessable Load (AL)

The assessable load for an activity is the smallest of actual, weighted or agreed loads. If you have more than one fee-based activity classification listed in D1, the assessable load for your licence is the sum of the assessable loads of this substance for each activity.

Assessable Load (AL) (kg)	5,550

D3 Calculate Fee Rate Threshold (FRT)

The Fee Rate Threshold is the amount of an assessable pollutant that may be discharged during the licence fee period before the fee rate for any further discharges of the assessable pollutant increases.

E.g. If you are a Cement Producer and you produced 500,000 tonnes of cement during the licence fee period, your calculated FRT for coarse particulates is:

FRT = 500,000 tonnes procedured x 0.23 (FRT factor for coarse particulates is 0.23 kg/tonne produced)
= 115,000 kg

	Actual quantity of activity (expressed in units of measure specified at A5)				calculated FRT
Ceramics production	52,912	X	0.0850000	=	4,498

If more than one activity, add calculated FRTs for each activity to obtain the total FRT for the pollutant

FRT 4,498

D4 Apply Fee Rate Threshold

Is the Assessable Load (D2) greater than the Fee Rate Threshold (D3)?

☒ Yes, calculate AL1 below

☐ No, go to D5

2 x AL (D2)		FRT (D3)		AL1
11,100	—	4,498	=	6,602

D5 Calculate Pollutant Fee for Coarse Particulates discharged to Air

Calculation Factor, CF = [pollutant fee unit amount x pollutant weighting x critical zone] / 10,000

= 41.58 x 18 x 1/10,000

Assessable Load AL or AL1		Calculation Factor (CF)		Pollutant Fee (PF)
6,602	x	0.0748440	=	$ 494.12

Copy Pollutant Fee (PF) for this assessable pollutant to the summary page at D6

Annual Return

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

Fine Particulates discharged to Air

D1 Pollutant Load

	actual load (kg)	weight load (kg)	'agreed' load (kg)
Ceramics production	997		

Actual Load

If applicable, the method used to calculate the **actual load** was:
(Method Numbers must be as per the NSW EPA's publication "Approved Methods for the Sampling and Analysis and Analysis of Air/Water Pollutants in NSW" referred to in the "Load Calculation Protocol".)

Ceramics production

- [x] Source Monitoring (SM) — Type of SM: PM; Method Number: OM5
- [ ] Emission Factors (EF) — Type of EF:
- [ ] Mass Balance (MB)
- [ ] Other EPA Approved Method

Has the calculation method of the actual load resulted in an underestimation of the amount of the assessable pollutant discharged?

- [ ] Yes
- [ ] No

Weight Load

If applicable, the **load weighting** measure used was:

Ceramics production

- [ ] Effluent re-use on site
- [ ] Effluent transfer beyond the licensed premises — If so, where to?
- [ ] Flow optimised discharge

Agreed Load

If applicable, the **agreed load** used was agreed under:

Ceramics production

- [ ] Load Reduction Agreement
- [ ] Bubble Licence Arrangement

D2 Assessable Load (AL)

The assessable load for an activity is the smallest of actual, weighted or agreed loads. If you have more than one fee-based activity classification listed in D1, the assessable load for your licence is the sum of the assessable loads of this substance for each activity.

Assessable Load (AL) (kg)	997

D3 Calculate Fee Rate Threshold (FRT)

The Fee Rate Threshold is the amount of an assessable pollutant that may be discharged during the licence fee period before the fee rate for any further discharges of the assessable pollutant increases.

E.g. If you are a Cement Producer and you produced 500,000 tonnes of cement during the licence fee period, your calculated FRT for coarse particulates is:

FRT = 500,000 tonnes procedured x 0.23 (FRT factor for coarse particulates is 0.23 kg/tonne produced)

= 115,000 kg

	Actual quantity of activity (expressed in units of measure specified at A5)				calculated FRT
Ceramics production	52,912	X	0.1100000	=	5,820

If more than one activity, add calculated FRTs for each activity to obtain the total FRT for the pollutant

FRT 5,820

D4 Apply Fee Rate Threshold

Is the Assessable Load (D2) greater than the Fee Rate Threshold (D3)?

☐ Yes, calculate AL1 below

☒ No, go to D5

2 x AL (D2)		FRT (D3)		AL1
	—		=	

D5 Calculate Pollutant Fee for Fine Particulates discharged to Air

Calculation Factor, CF = [pollutant fee unit amount x pollutant weighting x critical zone] / 10,000

= 41.58 x 125 x 1/10,000

Assessable Load AL or AL1		Calculation Factor (CF)		Pollutant Fee (PF)
997	x	0.5197500	=	$ 518.19

Copy Pollutant Fee (PF) for this assessable pollutant to the summary page at D6

Annual Return

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

Fluoride discharged to Air

D1 Pollutant Load

	actual load (kg)	weight load (kg)	'agreed' load (kg)
Ceramics production	91		

Actual Load

If applicable, the method used to calculate the **actual load** was:
(Method Numbers must be as per the NSW EPA's publication "Approved Methods for the Sampling and Analysis and Analysis of Air/Water Pollutants in NSW" referred to in the "Load Calculation Protocol".)

Ceramics production

- [X] Source Monitoring (SM) — Type of SM: PM; Method Number: TM9
- [ ] Emission Factors (EF) — Type of EF:
- Has the calculation method of the actual load resulted in an underestimation of the amount of the assessable pollutant discharged? [ ] Yes [ ] No
- [ ] Mass Balance (MB)
- [ ] Other EPA Approved Method

Weight Load

If applicable, the **load weighting** measure used was:

Ceramics production

- [ ] Effluent re-use on site
- [ ] Effluent transfer beyond the licensed premises — If so, where to?
- [ ] Flow optimised discharge

Agreed Load

If applicable, the **agreed load** used was agreed under:

Ceramics production

- [ ] Load Reduction Agreement
- [ ] Bubble Licence Arrangement

D2 Assessable Load (AL)

The assessable load for an activity is the smallest of actual, weighted or agreed loads. If you have more than one fee-based activity classification listed in D1, the assessable load for your licence is the sum of the assessable loads of this substance for each activity.

Assessable Load (AL) (kg)	91

D3 Calculate Fee Rate Threshold (FRT)

The Fee Rate Threshold is the amount of an assessable pollutant that may be discharged during the licence fee period before the fee rate for any further discharges of the assessable pollutant increases.

E.g. If you are a Cement Producer and you produced 500,000 tonnes of cement during the licence fee period, your calculated FRT for coarse particulates is:

FRT = 500,000 tonnes procedured x 0.23 (FRT factor for coarse particulates is 0.23 kg/tonne produced)

= 115,000 kg

	Actual quantity of activity (expressed in units of measure specified at A5)				calculated FRT
Ceramics production	52,912	x	0.1200000	=	6,349

If more than one activity, add calculated FRTs for each activity to obtain the total FRT for the pollutant

FRT 6,349

D4 Apply Fee Rate Threshold

Is the Assessable Load (D2) greater than the Fee Rate Threshold (D3)?

- ☐ Yes, calculate AL1 below
- ☒ No, go to D5

2 x AL (D2)		FRT (D3)		AL1
	—		=	

D5 Calculate Pollutant Fee for Fluoride discharged to Air

Calculation Factor, CF = [pollutant fee unit amount x pollutant weighting x critical zone] / 10,000

= 41.58 x 84 x 1/10,000

Assessable Load AL or AL1		Calculation Factor (CF)		Pollutant Fee (PF)
91	x	0.3492720	=	$ 31.78

Copy Pollutant Fee (PF) for this assessable pollutant to the summary page at D6

Annual Return

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

Nitrogen Oxides discharged to Air

D1 Pollutant Load

	actual load (kg)	weight load (kg)	'agreed' load (kg)
Ceramics production	20,306		

Actual Load

If applicable, the method used to calculate the **actual load** was:
(Method Numbers must be as per the NSW EPA's publication "Approved Methods for the Sampling and Analysis and Analysis of Air/Water Pollutants in NSW" referred to in the "Load Calculation Protocol".)

Ceramics production

- [x] Source Monitoring (SM) — Type of SM: PM; Method Number: TM 11
- [ ] Emission Factors (EF) — Type of EF:
- Has the calculation method of the actual load resulted in an underestimation of the amount of the assessable pollutant discharged? [ ] Yes [ ] No
- [ ] Mass Balance (MB)
- [ ] Other EPA Approved Method

Weight Load

If applicable, the **load weighting** measure used was:

Ceramics production

- [ ] Effluent re-use on site
- [ ] Effluent transfer beyond the licensed premises — If so, where to?
- [ ] Flow optimised discharge

Agreed Load

If applicable, the **agreed load** used was agreed under:

Ceramics production

- [ ] Load Reduction Agreement
- [ ] Bubble Licence Arrangement

D2 Assessable Load (AL)

The assessable load for an activity is the smallest of actual, weighted or agreed loads. If you have more than one fee-based activity classification listed in D1, the assessable load for your licence is the sum of the assessable loads of this substance for each activity.

Assessable Load (AL) (kg)	20,306

D3 Calculate Fee Rate Threshold (FRT)

The Fee Rate Threshold is the amount of an assessable pollutant that may be discharged during the licence fee period before the fee rate for any further discharges of the assessable pollutant increases.

E.g. If you are a Cement Producer and you produced 500,000 tonnes of cement during the licence fee period, your calculated FRT for coarse particulates is:

FRT = 500,000 tonnes procedured x 0.23 (FRT factor for coarse particulates is 0.23 kg/tonne produced)

= 115,000 kg

	Actual quantity of activity (expressed in units of measure specified at A5)				calculated FRT
Ceramics production	52,912	X	0.2200000	=	11,641

If more than one activity, add calculated FRTs for each activity to obtain the total FRT for the pollutant

FRT 11,641

D4 Apply Fee Rate Threshold

Is the Assessable Load (D2) greater than the Fee Rate Threshold (D3)?

☒ Yes, calculate AL1 below

☐ No, go to D5

2 x AL (D2)		FRT (D3)		AL1
40,612	—	11,641	=	28,971

D5 Calculate Pollutant Fee for Nitrogen Oxides discharged to Air

Calculation Factor, CF = [pollutant fee unit amount x pollutant weighting x critical zone] / 10,000

= 41.58 x 9 x 2/10,000

Assessable Load AL or AL1		Calculation Factor (CF)		Pollutant Fee (PF)
28,971	x	0.0748440	=	$ 2,168.31

Copy Pollutant Fee (PF) for this assessable pollutant to the summary page at D6

Annual Return

NATIONAL CERAMIC INDUSTRIES AUSTRALIA PTY LTD

Sulfur Oxides discharged to Air

D1 Pollutant Load

	actual load (kg)	weight load (kg)	'agreed' load (kg)
Ceramics production	26,946		

Actual Load

If applicable, the method used to calculate the **actual load** was:
(Method Numbers must be as per the NSW EPA's publication "Approved Methods for the Sampling and Analysis and Analysis of Air/Water Pollutants in NSW" referred to in the "Load Calculation Protocol".)

Ceramics production

- [x] Source Monitoring (SM) — Type of SM: PM; Method Number: TM 3
- [ ] Emission Factors (EF) — Type of EF:
- Has the calculation method of the actual load resulted in an underestimation of the amount of the assessable pollutant discharged? [ ] Yes [ ] No
- [ ] Mass Balance (MB)
- [ ] Other EPA Approved Method

Weight Load

If applicable, the **load weighting** measure used was:

Ceramics production

- [ ] Effluent re-use on site
- [ ] Effluent transfer beyond the licensed premises — If so, where to?
- [ ] Flow optimised discharge

Agreed Load

If applicable, the **agreed load** used was agreed under:

Ceramics production

- [ ] Load Reduction Agreement
- [ ] Bubble Licence Arrangement

D2 Assessable Load (AL)

The assessable load for an activity is the smallest of actual, weighted or agreed loads. If you have more than one fee-based activity classification listed in D1, the assessable load for your licence is the sum of the assessable loads of this substance for each activity.

Assessable Load (AL) (kg)	26,946

D3 Calculate Fee Rate Threshold (FRT)

The Fee Rate Threshold is the amount of an assessable pollutant that may be discharged during the licence fee period before the fee rate for any further discharges of the assessable pollutant increases.

E.g. If you are a Cement Producer and you produced 500,000 tonnes of cement during the licence fee period, your calculated FRT for coarse particulates is:

FRT = 500,000 tonnes procedured x 0.23 (FRT factor for coarse particulates is 0.23 kg/tonne produced)
= 115,000 kg

	Actual quantity of activity (expressed in units of measure specified at A5)				calculated FRT
Ceramics production	52,912	x	0.5300000	=	28,043

If more than one activity, add calculated FRTs for each activity to obtain the total FRT for the pollutant

FRT 28,043

D4 Apply Fee Rate Threshold

Is the Assessable Load (D2) greater than the Fee Rate Threshold (D3)?

- ☐ Yes, calculate AL1 below
- ☒ No, go to D5

2 x AL (D2)		FRT (D3)		AL1
	—		=	

D5 Calculate Pollutant Fee for Sulfur Oxides discharged to Air

Calculation Factor, CF = [pollutant fee unit amount x pollutant weighting x critical zone] / 10,000
= 41.58 x 2.20 x 1/10,000

Assessable Load AL or AL1		Calculation Factor (CF)		Pollutant Fee (PF)
26,946	x	0.0091476	=	$ 246.49

Copy Pollutant Fee (PF) for this assessable pollutant to the summary page at D6

D6 Load-Based Fee

Assessable pollutants	Pollutants fee from D5 for each pollutant
Coarse Particulates (Air)	$ 494.12
Fine Particulates (Air)	$ 518.19
Fluoride (Air)	$ 31.78
Nitrogen Oxides (Air)	$ 2,168.31
Sulfur Oxides (Air)	$ 246.49
Total of Assessable Pollutant Fees	$ 3,458.89
Less the administrative fee you paid last year to cover this reporting period. This amount would have been paid at the beginning of the licence period.	$ 7,150.00

NOTE: If you varied your licence during the reporting period and your administrative fee changed, enter the total administrative fee paid for the period. Please use your invoice for the upcoming reporting period which shows payment and the fee details for the last twelve months as a reference for determining your administrative fee. If you are unsure about the administrative fee you paid last year, please contact us on telephone 02 9995 5700.

Load-based Fee (if negative, write zero)	$ Zero

It is important to note that the load-based fee must **not** be paid at this time. A separate invoice for the load-based fee will be issued once the EPA receives the Annual Return and load data. This load-based fee must be submitted to the EPA by **90 days after 31-Jul-2012**

E Signature and Certification

This Annual Return may only be signed by a person(s) with legal authority to sign it as set out in the categories below. **Please tick (✓) the box** next to the category that describes how this Annual Return is being signed.

If you are uncertain about who is entitled to sign or which category to tick, please contact us on telephone 02 9995 5700.

If the licence holder is:		the Annual Return must be signed and certified:
an individual	☐	by the individual licence holder, or
	☐	by a person approved in writing by the EPA to sign on the licence holder's behalf
a company	☐	by affixing the common seal in accordance with Corporations Act 2001, or
	☐	by 2 directors, or
	☐	by a director and a company secretary, or
	☐	if a proprietary company that has a sole director who is also the sole company secretary – by that director, or
	☐	by a person delegated to sign on the company's behalf in accordance with the Corporations Act 2001 **and** approved in writing by the EPA to sign on the company's behalf.
a public authority (other than a council)	☐	by the Chief Executive Officer of the public authority, or
	☐	by a person delegated to sign on the public authority's behalf in accordance with its legislation **and** approved in writing by the EPA to sign on the public authority's behalf.
a local council	☐	by the General Manager in accordance with s.377 of the Local Government Act 1993, or
	☐	by affixing the seal of the council in a manner authorised under that Act.

It is an offence to supply any information in this form that is false or misleading in a material respect, or to certify a statement that is false or misleading in a material respect. There is a maximum penalty of $250,000 for a corporation or $120,000 for an individual.

I/We

- *declare that the information in the Monitoring and Complaints Summary in section B of this Annual Return is correct and not false or misleading in a material respect, and*
- *certify that the information in the Statement of Compliance in sections A, C and D and any pages attached to Section C is correct and not false or misleading in a material respect.*

If your licence has been transferred, suspended, surrendered or revoked by the EPA during this reporting period, cross out the dates below and specify the new dates to which this Annual Return relates below:

For the reporting period 01-Aug-2011 to 31-Jul-2012 or ____/____/____ to ____/____/____

SIGNATURE:_____ SIGNATURE:_____

NAME:
(printed)_____ NAME:
(printed)_____

POSITION:_____ POSITION:_____

DATE:_____/_____/_____ DATE:_____/_____/_____

SEAL(if signing under seal)

PLEASE ENSURE THAT ALL APPROPRIATE BOXES HAVE BEEN COMPLETED AND THAT THE CHECKLIST ON PAGE 2 OF THE ANNUAL RETURN HAS BEEN COMPLETED

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Appendix C

Ambient Air Monitoring Results

Appendix C Ambient Air Monitoring Results

Table C1 24 hour PM10 Monitoring (OEH 6-day schedule) – Northwest Monitoring Location

Monitoring Event	Monitoring Location	24-hr PM_{10} ($\mu g/m^3$)	24-hr PM_{10} Guideline Criterion ($\mu g/m^3$)
6-Aug-11	NW	29.8	50
12-Aug-11	NW	30.2	50
18-Aug-11	NW	18.4	50
24-Aug-11	NW	21.8	50
30-Aug-11	NW	28.9	50
5-Sep-11	NW	35.2	50
11-Sep-11	NW	13.3	50
17-Sep-11	NW	46	50
23-Sep-11	NW	71.9	50
29-Sep-11	NW	17.2	50
5-Oct-11	NW	17.2	50
11-Oct-11	NW	28.6	50
17-Oct-11	NW	23.4	50
23-Oct-11	NW	25.1	50
29-Oct-11	NW	27.3	50
4-Nov-11	NW	25.9	50
10-Nov-11	NW	53.1	50
16-Nov-11	NW	33	50
22-Nov-11	NW	20.8	50
28-Nov-11	NW	18.5	50
4-Dec-11	NW	27.7	50
10-Dec-11	NW	17.7	50
16-Dec-11	NW	35.2	50
22-Dec-11	NW	14.9	50
28-Dec-11	NW	24.9	50
3-Jan-12	NW	17.9	50
9-Jan-12	NW	28.2	50
21-Jan-12	NW	17.7	50
27-Jan-12	NW	14.5	50
31-Jan-12	NW	20.9	50
2-Feb-12	NW	14.4	50
8-Feb-12	NW	22	50

14-Feb-12	NW	19.8	50
20-Feb-12	NW	23.5	50
26-Feb-12	NW	16.1	50
3-Mar-12	NW	11.8	50
9-Mar-12	NW	27.4	50
15-Mar-12	NW	20.1	50
21-Mar-12	NW	17.2	50
27-Mar-12	NW	21.1	50
2-Apr-12	NW	32.8	50
8-Apr-12	NW	29.3	50
14-Apr-12	NW	19.4	50
20-Apr-12	NW	26.4	50
26-Apr-12	NW	26.4	50
2-May-12	NW	27.3	50
8-May-12	NW	46.5	50
14-May-12	NW	29.2	50
20-May-12	NW	18.5	50
26-May-12	NW	24.1	50
1-Jun-12	NW	21.2	50
7-Jun-12	NW	13.3	50
13-Jun-12	NW	12.4	50
19-Jun-12	NW	19.4	50
25-Jun-12	NW	32.8	50
1-Jul-12	NW	23.3	50
7-Jul-12	NW	19.6	50
13-Jul-12	NW	18.3	50
19-Jul-12	NW	12.7	50
25-Jul-12	NW	31.2	50
31-Jul-12	NW	20.6	50

Table C2 24-hour PM10 Monitoring (OEH 6 day schedule) – Southeast Monitoring Location

Monitoring Event	Monitoring Location	24-hr PM_{10}	24-hr PM_{10} Guideline Criterion
		($\mu g/m^3$)	($\mu g/m^3$)
06-Aug-11	SE	19.6	50
12-Aug-11	SE	15.8	50
18-Aug-11	SE	12.2	50
24-Aug-11	SE	8.2	50
30-Aug-11	SE	12	50
05-Sep-11	SE	12.3	50
11-Sep-11	SE	11	50
17-Sep-11*	SE	28.4	50
23-Sep-11**	SE	6.4	50
29-Sep-11	SE	8.1	50
05-Oct-11	SE	9.8	50
11-Oct-11	SE	17.8	50
17-Oct-11	SE	16.8	50
23-Oct-11	SE	23.2	50
29-Oct-11	SE	16	50
04-Nov-11	SE	15.2	50
10-Nov-11	SE	35.2	50
16-Nov-11	SE	28.9	50
22-Nov-11	SE	28.8	50
28-Nov-11	SE	13.6	50
04-Dec-11	SE	20.7	50
10-Dec-11	SE	29.9	50
16-Dec-11	SE	16.2	50
22-Dec-11	SE	12.2	50
28-Dec-11	SE	20.6	50
03-Jan-12	SE	15	50
09-Jan-12	SE	27.2	50
15-Jan-12	SE	14.5	50
21-Jan-12	SE	21.9	50
27-Jan-12	SE	13.6	50
02-Feb-12	SE	16.4	50
08-Feb-12	SE	20.2	50
14-Feb-12	SE	15.1	50
20-Feb-12	SE	18.2	50
26-Feb-12	SE	13.9	50

03-Mar-12	SE	17.3	50
09-Mar-12	SE	23.4	50
15-Mar-12	SE	13	50
21-Mar-12	SE	13.1	50
27-Mar-12	SE	12.3	50
02-Apr-12	SE	24.7	50
08-Apr-12	SE	29.7	50
14-Apr-12	SE	17.7	50
20-Apr-12	SE	17.5	50
26-Apr-12	SE	17.5	50
02-May-12	SE	16.2	50
08-May-12	SE	30.5	50
14-May-12	SE	18.5	50
20-May-12	SE	23	50
26-May-12	SE	18.1	50
01-Jun-12	SE	12.6	50
07-Jun-12	SE	7.7	50
13-Jun-12	SE	10	50
19-Jun-12	SE	18.4	50
25-Jun-12	SE	22.2	50
01-Jul-12	SE	23	50
07-Jul-12	SE	15.9	50
13-Jul-12	SE	13.6	50
19-Jul-12	SE	8	50
25-Jul-12	SE	11.7	50
31-Jul-12	SE	11.2	50

* Did not run - power tripped. Make up run 8/10/11

**Did not run - power tripped. Make up run 19/10/11

Table C3 24-hour Fluoride Monitoring (OEH 6 day schedule) – Northwest Monitoring Location

Monitoring Event	Monitoring Location	24-hr Particulate Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride Guideline Criterion ($\mu g/m^3$ as HF at STP)
06-Aug-11	NW HF1	0.017	0.037	0.054	2.9
12-Aug-11	NW HF1	0.017	0.186	0.203	2.9
18-Aug-11	NW HF1	0.018	0.203	0.221	2.9
24-Aug-11	NW HF1	0.017	0.101	0.118	2.9
30-Aug-11	NW HF1	0.018	0.133	0.151	2.9
05-Sep-11	NW HF1	0.018	0.069	0.087	2.9
11-Sep-11	NW HF1	0.018	0.079	0.097	2.9
17-Sep-11	NW HF1	0.016	0.062	0.078	2.9
23-Sep-11	NW HF1	0.017	0.074	0.091	2.9
29-Sep-11	NW HF1	0.019	0.093	0.112	2.9
05-Oct-11	NW HF1	0.017	0.068	0.085	2.9
11-Oct-11	NW HF1	0.016	0.058	0.074	2.9
17-Oct-11	NW HF1	0.016	0.121	0.137	2.9
23-Oct-11	NW HF1	0.017	0.212	0.229	2.9
29-Oct-11*	NW HF1		0.112	0.112	2.9
04-Nov-11	NW HF1	0.017	0.14	0.157	2.9
10-Nov-11	NW HF1	0.016	0.057	0.073	2.9
16-Nov-11	NW HF1	0.017	0.126	0.143	2.9
22-Nov-11	NW HF1	0.037	0.316	0.353	2.9
28-Nov-11	NW HF1	0.017	0.154	0.171	2.9
04-Dec-11	NW HF1	0.016	0.512	0.528	2.9
10-Dec-11	NW HF1	0.017	0.222	0.239	2.9
16-Dec-11	NW HF1	0.017	0.158	0.175	2.9
22-Dec-11	NW HF1	0.017	0.300	0.317	2.9
28-Dec-11	NW HF1	0.017	0.088	0.105	2.9
03-Jan-12	NW HF1	0.015	0.040	0.055	2.9
09-Jan-12	NW HF1	0.016	0.299	0.315	2.9
15-Jan-12	NW HF1	Did not run due to power issue			2.9
21-Jan-12	NW HF1	Did not run due to power issue			2.9
27-Jan-12	NW HF1	0.045	0.222	0.267	2.9
31-Jan-12	NW HF1	0.032	0.032	0.064	2.9
02-Feb-12	NW HF1	0.07	0.03	0.097	2.9
08-Feb-12	NW HF1	0.02	0.10	0.119	2.9

Monitoring Event	Monitoring Location	24-hr Particulate Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride Guideline Criterion ($\mu g/m^3$ as HF at STP)
14-Feb-12	NW HF1	0.02	0.22	0.234	2.9
03-Mar-12	NW HF1	0.019	0.091	0.110	2.9
09-Mar-12	NW HF1	0.014	0.061	0.075	2.9
15-Mar-12	NW HF1	0.015	0.086	0.101	2.9
17-Mar-12	NW HF1	0.02	0.835	0.855	2.9
21-Mar-12	NW HF1	0.02	0.171	0.191	2.9
23-Mar-12	NW HF1	0.021	0.117	0.138	2.9
27-Mar-12	NW HF1	0.021	0.095	0.116	2.9
02-Apr-12	NW HF1	0.02	0.319	0.339	2.9
08-Apr-12	NW HF1	0.011	0.175	0.186	2.9
14-Apr-12	NW HF1	0.011	0.116	0.127	2.9
20-Apr-12	NW HF1	0.02	0.269	0.289	2.9
26-Apr-12	NW HF1	0.012	0.065	0.077	2.9
02-May-12	NW HF1	0.014	0.172	0.186	2.9
08-May-12	NW HF1	0.108	0.165	0.273	2.9
14-May-12	NW HF1	0.018	0.133	0.151	2.9
20-May-12	NW HF1	0.022	0.24	0.262	2.9
26-May-12	NW HF1	0.062	0.125	0.187	2.9
01-Jun-12	NW HF1	0.012	0.561	0.573	2.9
07-Jun-12	NW HF1	0.013	0.093	0.106	2.9
13-Jun-12	NW HF1	0.011	0.163	0.174	2.9
19-Jun-12	NW HF1	0.021	0.1	0.121	2.9
25-Jun-12	NW HF1	0.012	0.039	0.051	2.9
01-Jul-12	NW HF1	0.066	0.117	0.183	2.9
07-Jul-12	NW HF1	0.021	0.226	0.247	2.9
13-Jul-12	NW HF1	0.025	0.185	0.210	2.9
19-Jul-12	NW HF1	0.087	0.115	0.202	2.9
25-Jul-12	NW HF1	0.022	0.124	0.146	2.9
31-Jul-12	NW HF1	0.022	0.037	0.059	2.9

** Gaseous paper not found by lab*

Table C4 24-hour Fluoride Monitoring (OEH 6 day schedule) – Southeast Monitoring Location

Monitoring Event	Monitoring Location	24-hr Particulate Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride Guideline Criterion ($\mu g/m^3$ as HF at STP)
06-Aug-11*	SE HF1	0.012	0.424	0.436	2.9
12-Aug-11	SE HF1	0.019	0.344	0.363	2.9
18-Aug-11	SE HF1	0.037	0.317	0.354	2.9
24-Aug-11	SE HF1	0.04	0.183	0.223	2.9
30-Aug-11	SE HF1	0.035	0.286	0.321	2.9
05-Sep-11	SE HF1	0.041	2.232	2.273	2.9
11-Sep-11	SE HF1	0.021	0.115	0.136	2.9
17-Sep-11	SE HF1	0.058	0.785	0.843	2.9
23-Sep-11	SE HF1	0.015	0.342	0.357	2.9
29-Sep-11	SE HF1	0.015	0.628	0.643	2.9
05-Oct-11	SE HF1	0.011	0.243	0.254	2.9
11-Oct-11	SE HF1	0.011	0.567	0.578	2.9
17-Oct-11	SE HF1	0.011	0.256	0.267	2.9
23-Oct-11	SE HF1	0.013	0.872	0.885	2.9
29-Oct-11	SE HF1	0.01	0.506	0.516	2.9
04-Nov-11	SE HF1	0.017	0.318	0.335	2.9
10-Nov-11	SE HF1	0.014	0.195	0.209	2.9
16-Nov-11	SE HF1	0.041	0.685	0.726	2.9
22-Nov-11	SE HF1	0.017	0.57	0.587	2.9
28-Nov-11	SE HF1	0.019	0.178	0.197	2.9
04-Dec-11	SE HF1	0.02	0.171	0.191	2.9
10-Dec-11	SE HF1	0.014	0.108	0.122	2.9
16-Dec-11	SE HF1	0.012	0.058	0.070	2.9
22-Dec-11	SE HF1	0.013	0.194	0.207	2.9
28-Dec-11	SE HF1	0.013	0.146	0.159	2.9
03-Jan-12	SE HF1	0.018	0.081	0.099	2.9
09-Jan-12	SE HF1	0.019	0.079	0.098	2.9
15-Jan-12	SE HF1	0.014	0.063	0.077	2.9
21-Jan-12	SE HF1	0.014	0.173	0.187	2.9
27-Jan-12	SE HF1	0.015	0.453	0.468	2.9
02-Feb-12	SE HF1	0.02	0.119	0.139	2.9
08-Feb-12	SE HF1	0.019	0.077	0.096	2.9
14-Feb-12	SE HF1	0.02	0.213	0.233	2.9

Monitoring Event	Monitoring Location	24-hr Particulate Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride ($\mu g/m^3$ as HF at STP)	24-hr Total Fluoride Guideline Criterion ($\mu g/m^3$ as HF at STP)
20-Feb-12	SE HF1	0.024	0.038	0.062	2.9
26-Feb-12	SE HF1	0.012	0.253	0.265	2.9
03-Mar-12	SE HF1	0.012	0.103	0.115	2.9
09-Mar-12	SE HF1	0.018	0.158	0.176	2.9
15-Mar-12	SE HF1	0.016	0.26	0.276	2.9
21-Mar-12	SE HF1	0.017	0.807	0.824	2.9
27-Mar-12	SE HF1	0.017	0.301	0.318	2.9
02-Apr-12	SE HF1	0.017	0.515	0.532	2.9
08-Apr-12	SE HF1	0.018	0.334	0.352	2.9
14-Apr-12	SE HF1	0.018	0.712	0.730	2.9
20-Apr-12	SE HF1	0.016	0.45	0.466	2.9
26-Apr-12	SE HF1	0.012	0.129	0.141	2.9
02-May-12	SE HF1	0.018	0.966	0.984	2.9
08-May-12	SE HF1	0.041	0.566	0.607	2.9
14-May-12	SE HF1	0.039	0.126	0.165	2.9
20-May-12	SE HF1	0.019	0.355	0.374	2.9
26-May-12	SE HF1	0.014	0.131	0.145	2.9
01-Jun-12	SE HF1	0.149	0.707	0.856	2.9
07-Jun-12	SE HF1	0.014	0.196	0.210	2.9
13-Jun-12	SE HF1	0.019	0.332	0.351	2.9
19-Jun-12	SE HF1	0.04	0.152	0.192	2.9
25-Jun-12	SE HF1	0.266	1.468	1.734	2.9
01-Jul-12	SE HF1	0.012	0.054	0.066	2.9
07-Jul-12	SE HF1	0.019	0.227	0.246	2.9
13-Jul-12	SE HF1	0.019	0.057	0.076	2.9
19-Jul-12	SE HF1	0.019	0.075	0.094	2.9
25-Jul-12	SE HF1	0.019	0.105	0.124	2.9
31-Jul-12	SE HF1	0.02	0.049	0.069	2.9

** Did not run due to power issue. Make up run 8/10/11*

Table C5 Weekly Fluoride Monitoring – Northwest Monitoring Location

Monitoring Period	Monitoring Location	Particulate Fluoride ($\mu g/m^3$ as HF at STP)	Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	Total Fluoride ($\mu g/m^3$ as HF at STP)	7-Day Guideline Criterion ($\mu g/m^3$ as HF at STP)
29/07/12 - 05/08/11	NW HF_7	0.031	0.062	0.093	1.7
05/08/11 - 11/08/11	NW HF_7	0.005	0.051	0.056	1.7
11/08/11 - 22/08/11	NW HF_7	0.013	0.02	0.033	1.7
22/08/11 - 26/08/11	NW HF_7	0.003	0.055	0.058	1.7
26/08/11 - 02/09/11	NW HF_7	0.014	0.035	0.049	1.7
02/09/11 - 07/09/11	NW HF_7	0.007	0.073	0.080	1.7
07/09/11 - 16/09/11	NW HF_7	0.007	0.005	0.012	1.7
16/09/11 - 22/09/11	NW HF_7	0.002	0.034	0.036	1.7
22/09/11 - 27/09/11	NW HF_7	0.01	0.014	0.024	1.7
27/09/11 - 04/10/11	NW HF_7	0.029	0.073	0.102	1.7
04/09/11 - 07/10/11	NW HF_7	0.007	0.103	0.110	1.7
07/10/11 - 13/10/11	NW HF_7	0.007	0.039	0.046	1.7
13/10/11 - 21/10/11	NW HF_7	0.002	0.037	0.039	1.7
21/10/11 - 28/10/11	NW HF_7	0.003	0.112	0.115	1.7
28/10/11 - 03/11/11	NW HF_7	0.002	0.02	0.022	1.7
3/11/11 - 11/11/11	NW HF_7	0.002	0.017	0.019	1.7
11/11/11 - 18/11/11	NW HF_7	0.009	0.005	0.014	1.7
18/11/11 - 25/11/11	NW HF_7	0.023	0.004	0.027	1.7
25/11/11 to 2/12/11	NW HF_7	0.055	0.024	0.079	1.7
2/12/11 to 9/12/11	NW HF_7	0.005	0.005	0.010	1.7
9/12/11 to 15/12/11	NW HF_7	0.013	0.025	0.038	1.7
15/12/11 to 23/12/11	NW HF_7	0.002	0.021	0.023	1.7
23/12/11 to 29/12/11	NW HF_7	0.002	0.007	0.009	1.7

Monitoring Period	Monitoring Location	Particulate Fluoride ($\mu g/m^3$ as HF at STP)	Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	Total Fluoride ($\mu g/m^3$ as HF at STP)	7-Day Guideline Criterion ($\mu g/m^3$ as HF at STP)
29/12/11 to 7/01/12	NW HF_7	0.004	0.033	0.037	1.7
7/1/12 to 13/1/12	NW HF_7	0.002	0.01	0.012	1.7
13/1/12 to 20/1/12	NW HF_7	Did not run due to power issue. Make up run 30/01/2012 to 3/2/12			1.7
20/1/12 to 25/1/12	NW HF_7	0.007	0.006	0.013	1.7
25/01/2012 to 30/1/12	NW HF_7	0.003	0.005	0.008	1.7
30/01/2012 to 3/2/12	NW HF_7	0.008	0.005	0.013	1.7
3/02/2012 to 10/2/2012	NW HF_7	0.007	0.178	0.185	1.7
10/02/2012 to 17/02/2012	NW HF_7	0.005	0.011	0.016	1.7
17/02/2012 to 24/02/2012	NW HF_7	0.023	0.116	0.139	1.7
24/02/2012 to 1/03/2012	NW HF_7	0.046	0.103	0.149	1.7
1/03/2012 to 8/3/2012	NW HF_7	0.002	0.004	0.006	1.7
8/3/2012 to 16/3/2012	NW HF_7	0.019	0.144	0.163	1.7
16/3/2012 to 22/3/2012	NW HF_7	0.065	0.095	0.160	1.7
22/3/2012 to 29/3/2012	NW HF_7	0.055	0.083	0.138	1.7
29/3/2012 to 5/4/2012	NW HF_7	0.029	0.186	0.215	1.7
5/4/2012 to 13/4/2012	NW HF_7	0.012	0.18	0.192	1.7
13/4/2012 to 19/4/2012	NW HF_7	0.014	0.207	0.221	1.7
19/4/2012 to 27/4/2012	NW HF_7	0.011	0.097	0.108	1.7
27/4/2012 to 4/5/2012	NW HF_7	0.09	0.246	0.336	1.7
4/5/2012 to 11/5/2012	NW HF_7	0.059	0.067	0.126	1.7
11/5/2012 to 18/5/2012	NW HF_7	0.019	0.052	0.071	1.7
18/5/2012 to 25/5/2012	NW HF_7	0.05	0.045	0.095	1.7
25/5/2012 to 31/5/2012	NW HF_7	0.13	0.622	0.752	1.7
31/5/2012 to 8/6/2012	NW HF_7	0.029	0.05	0.079	1.7

Monitoring Period	Monitoring Location	Particulate Fluoride ($\mu g/m^3$ as HF at STP)	Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	Total Fluoride ($\mu g/m^3$ as HF at STP)	7-Day Guideline Criterion ($\mu g/m^3$ as HF at STP)
8/6/2012 to 15/6/2012	NW HF_7	0.028	0.175	0.203	1.7
15/6/2012 to 22/6/2012	NW HF_7	0.068	0.083	0.151	1.7
22/6/2012 to 29/6/2012	NW HF_7	0.105	0.198	0.303	1.7
29/6/2012 to 6/7/2012	NW HF_7	0.028	0.238	0.266	1.7
6/7/2012 to 12/7/2012	NW HF_7	0.024	0.192	0.216	1.7
12/7/2012 to 20/7/2012	NW HF_7	0.081	0.095	0.176	1.7
20/7/2012 to 27/7/2012	NW HF_7	0.04	0.354	0.394	1.7

Table C6 Weekly Fluoride Monitoring – Southeast Monitoring Location

Monitoring Event	Monitoring Location	Particulate Fluoride ($\mu g/m^3$ as HF at STP)	Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	Total Fluoride ($\mu g/m^3$ as HF at STP)	7-Day Guideline Criterion ($\mu g/m^3$ as HF at STP)
29/07/11 - 05/08/11	SE HF7	0.011	0.055	0.066	1.7
05/08/11 - 11/08/11	SE HF7	0.003	0.031	0.034	1.7
11/08/11 - 22/08/11	SE HF7	0.003	0.002	0.005	1.7
22/08/11 - 26/08/11	SE HF7	0.005	0.047	0.052	1.7
26/08/11 - 02/09/11	SE HF7	0.011	0.138	0.149	1.7
02/09/11 - 07/09/11	SE HF7	0.003	0.057	0.060	1.7
07/09/11 - 16/09/11	SE HF7	0.005	0.007	0.012	1.7
16/09/11 - 22/09/11	SE HF7	0.004	0.065	0.069	1.7
22/09/11 - 27/09/11	SE HF7	0.007	0.006	0.013	1.7
27/09/11 - 04/10/11	SE HF7	0.003	0.003	0.006	1.7
04/09/11 - 07/10/11	SE HF7	0.005	0.057	0.062	1.7
07/10/11 - 13/10/11	SE HF7	0.003	0.014	0.017	1.7
13/10/11 - 21/10/11	SE HF7	0.002	0.067	0.069	1.7
21/10/11 - 28/10/11	SE HF7	0.002	0.017	0.019	1.7
3/11/11 - 7/11/11	SE HF7	0.004	0.089	0.093	1.7
7/11/11 - 11/11/11	SE HF7	0.004	0.152	0.156	1.7
11/11/11 - 18/11/11	SE HF7	0.002	0.005	0.007	1.7
18/11/11 - 25/11/11	SE HF7	0.005	0.002	0.007	1.7
25/11/11 - 2/12/11	SE HF7	0.002	0.007	0.009	1.7
2/12/11 to 9/12/11	SE HF7	0.002	0.006	0.008	1.7
9/12/11 to 15/12/11	SE HF7	0.003	0.032	0.035	1.7
15/12/11 to 23/12/11	SE HF7	0.002	0.012	0.014	1.7
23/12/11 to 29/12/11	SE HF7	0.003	0.005	0.008	1.7

Monitoring Event	Monitoring Location	Particulate Fluoride ($\mu g/m^3$ as HF at STP)	Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	Total Fluoride ($\mu g/m^3$ as HF at STP)	7-Day Guideline Criterion ($\mu g/m^3$ as HF at STP)
29/12/11 to 7/1/12	SE HF7	0.002	0.03	0.032	1.7
7/1/12 to 13/1/12	SE HF7	0.003	0.011	0.014	1.7
13/1/12 to 20/1/12	SE HF7	0.002	0.017	0.019	1.7
20/1/12 to 25/1/12	SE HF7	0.003	0.005	0.008	1.7
25/01/2012 to 3/02/12	SE HF7	0.002	0.001	0.003	1.7
3/02/2012 to 10/2/2012	SE HF7	0.003	0.002	0.005	1.7
10/02/2012 to 17/02/2012	SE HF7	0.002	0.041	0.043	1.7
17/02/2012 to 24/02/2012	SE HF7	0.002	0.033	0.035	1.7
24/02/2012 to 1/03/2012	SE HF7	0.003	0.107	0.110	1.7
1/03/2012 to 8/3/2012	SE HF7	0.002	0.004	0.006	1.7
8/3/2012 to 16/3/2012	SE HF7	0.009	0.131	0.140	1.7
16/3/2012 to 22/3/2012	SE HF7	0.008	0.079	0.087	1.7
22/3/2012 to 29/3/2012	SE HF7	0.023	0.148	0.171	1.7
29/3/2012 to 5/4/2012	SE HF7	0.011	0.203	0.214	1.7
5/4/2012 to 13/4/2012	SE HF7	0.016	0.156	0.172	1.7
13/4/2012 to 19/4/2012	SE HF7	0.002	0.081	0.083	1.7
19/4/2012 to 27/4/2012	SE HF7	0.01	0.039	0.049	1.7
27/4/2012 to 4/5/2012	SE HF7	0.011	0.174	0.185	1.7
4/5/2012 to 11/5/2012	SE HF7	0.012	0.207	0.219	1.7
11/5/2012 to 18/5/2012	SE HF7	0.062	0.191	0.253	1.7
18/5/2012 to 25/5/2012	SE HF7	0.071	0.312	0.383	1.7
25/5/2012 to 31/5/2012	SE HF7	0.021	0.507	0.528	1.7
31/5/2012 to 8/6/2012	SE HF7	0.008	0.066	0.074	1.7
8/6/2012 to 15/6/2012	SE HF7	0.018	0.142	0.160	1.7

Monitoring Event	Monitoring Location	Particulate Fluoride ($\mu g/m^3$ as HF at STP)	Gaseous Fluoride ($\mu g/m^3$ as HF at STP)	Total Fluoride ($\mu g/m^3$ as HF at STP)	7-Day Guideline Criterion ($\mu g/m^3$ as HF at STP)
15/6/2012 to 22/6/2012	SE HF7	0.13	0.322	0.452	1.7
22/6/2012 to 29/6/2012	SE HF7	0.005	0.039	0.044	1.7
29/6/2012 to 6/7/2012	SE HF7	0.031	0.139	0.170	1.7
6/7/2012 to 12/7/2012	SE HF7	0.03	0.175	0.205	1.7
12/7/2012 to 20/7/2012	SE HF7	0.045	0.093	0.138	1.7
20/7/2012 to 27/7/2012	SE HF7	0.018	0.113	0.131	1.7

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Appendix D

Annual Vegetation Condition Assessment

Appendix D Annual Vegetation Condition Assessment

National Ceramic Industries Australia
02 February 2012

NCIA Annual Vegetation Condition Assessment

NCIA Annual Vegetation Condition Assessment

Prepared for

National Ceramic Industries Australia

Prepared by

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AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

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1.0 Introduction

AECOM Australia Pty Limited (AECOM) was appointed by National Ceramic Industries Australia Pty Limited (NCIA) to perform annual vegetation surveys to investigate the potential effect of fluoride emissions on vegetation surrounding their Rutherford ceramic tile manufacturing facility. Annual and quarterly visual and foliar fluoride content surveys are an integral component of regulatory environmental monitoring requirements as defined in Condition 5.8 of the Development Consent (DIPNR, 2003) and Condition M4.1 of Environment Protection Licence (EPL) 11956 (NSW EPA, April 2004).

The monitoring of the effects of fluoride on vegetation surrounding the NCIA premises commenced in 2004. The survey methodology was developed by Dr David Doley (University of Queensland). This report describes the background to fluoride impact monitoring, outlines survey assessment procedures, and presents the findings of the 2011 Annual survey undertaken on 13 December 2011.

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2.0 Fluoride Vegetation Impact Monitoring Background

2.1 Monitoring Requirements

Fluoride monitoring requirements defined in Condition M4.1 of the Environment Protection Licence (NSW EPA, 2004) are shown below, and are based on the monitoring program proposed by AECOM on behalf of NCIA (HLA-Envirosciences - now AECOM). These monitoring requirements repeal those requirements defined in Condition 5.8 of the Development Consent, which did not acknowledge site-specific characteristics (including the simplified vegetation community structure and vegetation values) and the low contribution to background hydrogen fluoride (HF) concentrations predicted for the operation of the ceramic tile manufacturing facility. The proposed monitoring program has been reviewed and accepted by the Department of Infrastructure, Planning and Natural Resources (DIPNR; now the Department of Planning and Infrastructure).

M4.1 The licensee must monitor the impact of fluoride on vegetation as follows:

a) Annual and quarterly visual assessment of vegetation in the area surrounding the premises as outlined in the document titled Proposed Ambient Air Quality Monitoring Programs – National Ceramic Industries Australia, Rutherford dated January 2004.

b) Quarterly monitoring of the fluoride content in vegetation in the area surrounding the premises as outlined in the document titled Proposed Ambient Air Quality Monitoring Programs – National Ceramic Industries Australia, Rutherford dated January 2004.

The licensee must maintain a list and a map of the monitoring sites used to assess the impact of the premises on the surrounding environment.

Part of each sample analysed must be carefully stored to the satisfaction of the EPA for a period of not less than 12 months and forwarded to the EPA on request.

2.2 Background Vegetation Impact Assessment

Dr David Doley of the University of Queensland undertook a background fluoride vegetation impact survey on 21 and 22 January 2004. Dr Doley's research interests were in the area of ecophysiology, with projects focusing on rainforest research, forest rehabilitation and air pollution studies. Dr Doley has been instrumental in the development and reporting of vegetation monitoring and assessments of fluoride impact for a range of industries in Australia and New Zealand, with emphasis on power generation and aluminium smelting. The methodology adopted for use in the current survey (described in Section 3.0) was developed by Dr Doley.

As described in HLA-Envirosciences (2004) (now AECOM), elevated background fluoride concentrations are found in the air around the NCIA facility at Rutherford. These concentrations are attributable to aluminium smelting operations in Kurri Kurri and power generating activities in the Upper Hunter Valley.

Data collected during the background fluoride vegetation impact survey offer a baseline to which data from subsequent monitoring surveys may be compared. This comparison can then be used to evaluate the effect of the NCIA operations on local vegetation.

2.2.1 Implications of the Predicted Ground Level Concentrations

Maximum 90-day average fluoride concentrations associated with emissions from the ceramic tile facility were developed by Holmes Air Sciences for the Environmental Impact Statement (EIS) (Parsons Brinkerhoff, 2002) prepared for the facility. These concentrations (between 0.005 and 0.1 $\mu g/m^3$) are less than one-fifth of the ambient guideline values for general land use (0.50 $\mu g/m^3$; ANZECC 1990), and less than half that of the ambient guideline values for special land uses, which include areas with grape vines (0.25 $\mu g/m^3$; ANZECC 1990). A concentration of 0.01$\mu g/m^3$ is used as the default minimum concentration for 7-day average fluoride determinations by the Hydro Aluminium smelter at Kurri Kurri.

Ambient fluoride concentrations in the vineyards closest to the Hydro Aluminium smelter are commonly around 0.1 $\mu g/m^3$. Concentrations of approximately 0.2 $\mu g/m^3$ during the 1997-98 growing season were not associated with any detectable alteration in grape yield or quality (Doley, McNaughton & Wenta, 2003a).

Vineyards distant from the Kurri Kurri smelter record ambient concentrations between 0.01 and 0.12 $\mu g/m^3$, with some evidence of visible injury to leaves, but no indication of any effect on yield or quality of grapes (Doley *et al.*,

2003a). A substantial portion of the fluoride occurring in grape leaves more than 20 km from the Kurri Kurri smelter can be attributed to emissions from the coal-fired electric power stations in the Hunter Valley (Taylor, Rothe & Taylor, 2003).

Figure 3.2 of the EIS (Parsons Brinckerhoff, 2002) illustrates land uses in the vicinity of the site. The principal land uses in the areas of highest predicted ambient fluoride concentration to the southeast of the works are: the former Westside Golf Course between 0 and 1 km; residential at 0.8 km and beyond; and secondary agriculture at 0.5 km and beyond (south of the Main North Railway Line). To the northwest of the site, an area assigned to general industry extends from the works boundary for about 0.6 km, beyond which is a large area of secondary agriculture.

3.0 Methodology

The assessment procedure defined in the background survey (HLA-Envirosciences, 2004 - now AECOM), and reproduced below, was adopted for this 2011 annual monitoring survey. As opposed to quarterly surveys which assess the condition of a shortlisted selection of fluoride sensitive species, the annual survey provides an opportunity to undertake a more comprehensive investigation and investigates all specimens studied in the background survey.

3.1 Monitoring Locations

The annual vegetation survey was carried out on 13 December 2011 in the vicinity of the NCIA site (Rutherford, NSW). Visual inspections and sample collections were performed by Matthieu Catteau and James McIntyre of AECOM. The scope of the survey was based on the distribution and concentrations of fluoride predicted in the EIS by Holmes Air Sciences (refer to Parsons Brinckerhoff, 2002). The maximum ground-level concentration of fluoride over a 90-day averaging period was predicted to approach 0.1μgHF/m^3 between 0.3 and 1.8 km southeast from the source (based on operation of four kilns). To the northwest of the site, the maximum 90-day HF concentration was predicted to be approximately 0.02 μgHF/m^3 between the source and a distance of 3 km. These patterns of distribution of ambient concentration reflect the prevailing wind directions (NW in winter and SE in summer). They do not take into account the existing background concentrations of fluoride in air.

The survey used locations selected previously and was directed at plant species considered most likely to exhibit visible injury symptoms from atmospheric fluoride. For comparison purposes, five survey locations were at sites where foliage fluoride concentrations had been monitored during previous years.

The survey sites are listed in Table 1 and their location shown on Figure 1. Vegetation was assessed on the NCIA works site and at locations that could be viewed from public land, plus a control site on private property at 200 Anambah Road. Four additional sites were established in the residential area of Rutherford to the south-east of the NCIA works and two additional sites were established in Gardiner Road, to the west of the works. Only minor changes occurred in the composition of species lists at the various sites.

Table 1 Locations used for assessment of fluoride injury in vegetation in the vicinity of the NCIA works at Rutherford

Location	Site #	Location from kiln stack	Description
NCIA premises	1	280m NW	Access road north of office
	2	120m W	Office car park
	3	160m W	Access road south of office
	4	220m SW	South-west corner of site
	5	300m SE	South-east corner of site
Rutherford residential area and Farley	6	1.4km E	3 Palisade Street
	7	1.4km SE	Gillette Close
	8	1.5km SE	Regiment Road east of Dumont Court
	9	1.8kmSE	Regiment Road south-east of Squadron Crescent
	10	2km SE	Wollombi Road between sewage works and creek
	11	1.5km SE	Hill top on Wollombi Road west of Owl Pen Lane, Farley
	12	2.2km S	Western end of Quarry Road, Farley
Rutherford industrial estate	13	480m N	NCIA entrance, Racecourse Road
	14	570m NW	100-104 Kyle Street
	15	500m NW	11 Gardiner Road
	16	450m W	56 Gardiner Road
	17	550 SW	Gardiner Road, southern end

Location	Site #	Location from kiln stack	Description
	18	920m NW	Maitland Saleyards, Kyle Street
Anambah homestead	19	3km N	200 Anambah Road – Reference site

National Ceramics Industry Australia
Vegetation Monitoring Locations
Source: Google Earth Pro (2011)

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Fig. **1**

3.2 Species Monitored

Attention was directed to plant species considered most likely to exhibit visible injury symptoms from atmospheric fluoride. The principal species are listed in Table 2.

Table 2 Plant species occurring in vicinity of the NCIA Plant which are known to exhibit visible injury symptoms from atmospheric fluoride

Species	Common name	Habit
Acacia fimbriata	Brisbane Wattle	Shrub
Acacia longifolia	Sallow Wattle	Shrub
Angophora costata	Smooth Barked Apple	Tree
Angophora floribunda	Rough Barked Apple	Tree
Bursaria spinosa	Blackthorn	Shrub
Corymbia maculata	Spotted Gum	Tree
Dianella caerulea	Blue Flax-lily	Herb
Eucalyptus amplifolia	Cabbage Gum	Tree
Eucalyptus botryoides	Southern Mahogany	Tree
Eucalyptus fibrosa	Red Ironbark	Tree
Eucalyptus moluccana	Gum topped Box	Tree
Eucalyptus paniculata	Grey Ironbark	Tree
Eucalyptus punctata	Grey Gum	Tree
Eucalyptus resinifera	Red Stringybark	Tree
Eucalyptus robusta	Swamp Mahogany	Tree
Fraxinus excelsior	European Ash	Tree
Fraxinus pennsylvanica	Green Ash	Tree
Grevillea robusta	Silky Oak	Tree
Pinus radiata	Radiata Pine	Tree
Populus nigra var. *italica*	Lombardy Poplar	Tree

3.3 Weather Conditions

Monthly temperature and rainfall in the Rutherford area for 2011 is shown in Table 3. Long term averages are also provided for comparison purposes. Mean temperatures for the 2010-11 growing season were within the average trend. Although late summer and autumn received below average rainfall, winter and spring recorded significant rainfall, making 2011 a particularly wet year. Indeed, rainfall between July and December was approximately 60% higher in 2011 than the last 15-year average. As a result, shoot growth in most tree and shrub species was vigorous and foliage densities in crowns were dense at the time of survey.

Table 3 2011 temperature and rainfall, Rutherford (Source: Bureau of Meteorology, 2012)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Mean Maximum Temperature (°C) (1997-2011)	30.4	29.7	27.5	24.4	21.1	18.4	18	19.8	23	25.2	26.7	28.9	24.4
2011 Mean Maximum Temperature (°C)	30.8	31.4	28.2	23.4	20.2	18.5	16.9	19	22.3	23.9	27.7	24.6	23.9

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Mean Rainfall (mm) (1997-2011)	43.4	108.4	90.5	84	67.3	86.4	48.7	33.5	54.4	65.1	88.2	67.5	837.2
2011 Rainfall (mm)	36	22.5	36	94.5	40	158.5	70.5	46.5	104	76.5	160.5	99	944.5

3.4 Assessment of Vegetation

The monitoring of vegetation for effects of gaseous fluoride is based on the very high sensitivity of plant species, as compared with animals, to the accumulation of fluoride in tissue (Weinstein and Davison 2004). A consequence of this phenomenon is that injury may be detected in plant species under conditions that pose no risk to the health of humans and other animals. Within different plant groups, there is normally a range of sensitivities of species to fluoride, and within species, there will be some variation in the sensitivity of individual varieties or plants. Some of the more sensitive plant species are those of commercial or aesthetic interest, such as grapevines, peaches and gladiolus[1], or ecologically important native species, such as Spotted Gum (*Corymbia maculata*).

Vegetation monitoring is a valuable adjunct to other aspects of environmental management associated with a fluoride-emitting activity, as it can indicate the effects of both integrated fluoride exposure and under some circumstances, evidence of acute exposures. The nature of these indications will vary according to the pattern in time of ambient fluoride concentration and the presence of suitable species for monitoring purposes, namely those that are sensitive to fluoride. Visible injury to foliage is commonly used to indicate fluoride effects, as the measurement of growth in wild plants is unreliable due to the highly variable and uncontrolled effects of climatic factors, pests and disease on the patterns and amount of shoot growth in any given year. Australian plant species that are useful indicators of fluoride effects, their symptoms and some related factors are described by Doley (1986) and Doley et al. (2004).

3.4.1 Classification of Visible Injury Symptoms

A semi-quantitative scale of injuries was applied to selected species that occurred relatively widely over the area and expressed symptoms that could be associated reliably with fluoride exposure. Where other environmental stresses were likely to occur, attempts were made to determine their relative contributions to the categories of stress expressed in the foliage.

Grades of injury, described in Table 4, were used to simplify the process of assessment, to enable rapid and repeatable assessment of the extent of injury to foliage of different species, age or position at any location. The combinations of these symptoms vary between species for a given level of injury, and Table 5 summarises the combinations for some more common groups of plant species in the Rutherford area.

Visible injury symptoms were compared with the scales of maximum injury described in Table 4. Categories were determined arbitrarily, and with increasing steps of injury, to reflect the range of value judgments that may be associated with the concept of aesthetic environmental harm. For each category, the value in Table 4 indicates the maximum expression of injury associated with that category. The occurrence of injury was assessed on the one-tenth portion of leaves of a particular age class that expressed the greatest injury. This allowed for the common phenomenon that injury was confined to a relatively small portion of the growing season.

- **Injury Category 1** could be detected consistently by an experienced observer or by a person with a professional or serious interest in plant condition, such as a competitive horticulturist. It is very unlikely to have adverse effects on total plant growth or plant reproduction.
- **Injury Category 2** could be detected consistently by an inexperienced observer. It would be expected to cause offence to a person with a serious interest in plant condition, such as a competitive horticulturist. It is very unlikely to have adverse effects on total plant growth or plant reproduction.
- **Injury Category 3** would be obvious to an inexperienced observer, and that would seriously impair the aesthetic quality of the plant for purposes such as commercial floriculture. It would be expected to offend a dedicated home gardener. It is unlikely to have adverse effects on plant growth or reproduction.

[1] Due to the practicality of accessing these species, these species are not monitored as part of this annual survey.

- **Injury Category 4** would be obvious on casual inspection to an inexperienced observer. It could reasonably be judged to be "offensive or objectionable to such an extent that it has an adverse effect on the environment", in that an average home gardener would be likely to be offended by these conditions in horticultural specimens. The growth of a plant and the yield of foliage, fruit or other products from the plant may be impaired. If this level of injury occurred over a whole crop, it would be expected to be associated with reduced commercial yield and to be of concern to the manager of a commercial crop.
- **Injury Category 5** would be obvious to a casual observer at a distance from a plant and would be likely to result in the premature loss of foliage, loss of vigour of growth in the following season, and in some species the failure of flowering.
- **Injury Category 6** would be obvious to uninterested observers. It is likely to result in the premature death and loss of foliage, death of shoot tips, reduction in vigour of regrowth, and failure of flowering and fruit set.
- **Injury Category 7** would be very obvious from a distance to uninterested observers. It is likely to be associated with rapid death of foliage and shoot tips and, if repeated, the death of even large perennial plants.

Table 4 Symptom code for visible injury to vegetation, with particular reference to vegetation

Category	Tip necrosis or chlorosis % length	Marginal necrosis / chlorosis % width/area	Undulation/ cupping	Anthocyanin accumulation % 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%

Other visible injury parameters that are not attributable to fluoride impact, including leaf chewing index, sap sucking index, branch dieback and crown density, were also assessed during the survey (refer to Section 4.0). Whilst not explicitly defined, the symptom code/category system adopted for the assessment of these parameters is consistent with that defined for fluoride injury parameters defined in Table 4. Furthermore, evidence of vegetation reproduction, such as the observation of buds and/or fruits or flowers, was noted as present (designated '✓') or absent (designated '0').

Combinations of injury characteristic of different aged foliage in some more common plant groups are indicated in Table 5.

Table 5 Categories of visible injury attributable to fluoride emissions in selected plant species

Species	Category	Symptoms	
		Current Season Leaves	Previous Season Leaves
All	0	No visible injury	No visible injury
Eucalyptus, *Angophora, Corymbia* and *Acacia* species	1	No visible injury	Slight marginal/interveinal chlorosis and cupping or undulation
	2	Very slight marginal and/or interveinal chlorosis and cupping or undulation	Distinct marginal/interveinal chlorosis and cupping or undulation, tip necrosis < 5%
	3	Slight marginal and/or interveinal chlorosis and cupping or undulation	Marked marginal/interveinal chlorosis, cupping, tip necrosis < 10%, scattered marginal necrosis

Species	Category	Symptoms	
		Current Season Leaves	Previous Season Leaves
	4	Distinct marginal and/or interveinal chlorosis and cupping or undulation, tip necrosis < 5%	Marked marginal/interveinal chlorosis and cupping, tip necrosis < 20%, marginal necrosis < 3 mm
	5	Marked marginal and/or interveinal chlorosis and cupping, tip necrosis < 10%	Severe marginal/interveinal chlorosis and cupping, tip necrosis < 50%, marginal necrosis > 3 mm
	6	Marked marginal and/or interveinal chlorosis and cupping, tip necrosis < 20%, marginal necrosis < 3 mm	Severe marginal/interveinal chlorosis and cupping, tip necrosis > 50%, marginal necrosis > 50% width
	7	Severe marginal and/or interveinal chlorosis and cupping, tip necrosis > 20%, marginal necrosis > 3 mm	Leaves shed
Pinus radiata	1	Tip necrosis < 2%	Tip necrosis < 5%
	2	Tip necrosis < 5%	Tip necrosis < 10%
	3	Tip necrosis < 10%	Tip necrosis < 25%
	4	Tip necrosis < 25%	Tip necrosis < 50%
	5	Tip necrosis < 50%	Tip necrosis < 75%
	6	Tip necrosis < 75%	Tip necrosis > 75%
	7	Tip necrosis > 75%	Needles shed
Deciduous ornamental species	1	Very slight marginal and interveinal chlorosis, affecting < 5 area	N/A
	2	Slight marginal and interveinal chlorosis, affecting < 10 area	N/A
	3	Distinct marginal and interveinal chlorosis, < 25% area, marginal necrosis < 3 mm	N/A
	4	Marked marginal and interveinal chlorosis, < 50% area, marginal necrosis < 6 mm	N/A
	5	Severe marginal and interveinal chlorosis, < 75% area, marginal necrosis > 6 mm	N/A
	6	Very severe marginal and interveinal chlorosis, < 90% area, marginal necrosis > 6 mm	N/A
	7	Extreme marginal and interveinal chlorosis, > 90% area, marginal necrosis > 6 mm	N/A

Note: The combination of symptoms for each category of the code will vary with leaf age and with other stress conditions.

3.5 Interpretation of Injury Symptoms

3.5.1 Field Recording

In the application of the injury code in the field, the extent of injury to foliage affected by injury of a particular type was estimated for the one-tenth portion of leaves showing greatest injury on representative branches or plants, and this figure was applied to the species in question at that location. The one-tenth portion of leaves was selected because, in many situations, the distribution of injury within a growing season was not uniform. Expression of injury on a majority of branches or plants in a particular exposure situation was adopted, because air pollutants would be expected to cause similar injury to all leaves on one large plant of a given age and exposure situation. The extent of injury commonly varies even within leaves and an average injury estimate was

used. For example, marginal chlorosis may be irregular in its occurrence throughout a leaf, and it was assessed as an average percentage of leaf width affected.

3.5.2 Injury Category

Injury ratings for necrosis, chlorosis or leaf-chewing insect injury were applied independently in each determination. An overall Injury Category was assigned to a species at a site on the basis of the highest injury category for any criterion. This was adopted in order to identify the extent of injury that could be attributed to all stresses, including non-pollutant stresses such as drought, storm winds, disease or insect attack.

3.5.3 Emission Injury

An emissions category was assigned for symptoms or for that portion of a symptom expression that was attributable to fluoride exposure. The contribution of emissions to the total injury was estimated where there were considered to be clear differences in the amount of injury attributable to natural environmental stresses and those associated with the emission source.

Symptoms including cupping or buckling of the leaf blade, necrosis of the tips or margins of the leaves may be caused by several different factors, including fluoride exposure. In addition, the combination and relative expression of different symptoms is of considerable assistance in diagnosing pollutant injury in different species. All of these considerations may result in a moderation of the estimate of pollutant injury from that recorded in the field survey.

3.5.4 Foliage Age

For evergreen species, the Code may be applied separately for leaves of different age, as current season leaves may be uninjured whilst one-year-old or older leaves may show injury or may show a different combination of symptoms from those in current season leaves.

Where there are clear differences in the extent of injury to foliage at different positions on an annual shoot, the portions of seasonal growth may be indicated, together with the possible causes of injury. The actual ages of foliage will vary between species, depending on their major season of growth.

Foliage is classified as 0 (current season) or 1 year of age (previous season). Deciduous species have only a single leaf age class, but in many evergreen species, previous season leaves are shed or may begin to deteriorate soon after the current season shoot has completed expansion. Where one-year-old foliage is judged to be senescent, assessment is usually restricted to current season foliage. Where examinations are made before the growing season has ended, foliage from two growing seasons may be used to provide separate estimates of injury.

For many species, there is a relatively consistent relationship between the degrees of injury expressed in current season and one-year-old foliage, with the older leaves often showing injury of one category higher than the current season leaves (roughly double the extent of injury for most classes). In order to make comparisons between leaf ages and times of inspection during the growing season, the injury category for current season leaves is generally used, or deduced from expressions of injury in one-year-old leaves.

3.5.5 Position and Orientation of Foliage

Both large-scale (hundreds of metres) and small-scale (metres) patterns of distribution of injury should be consistent with the causal agent. For example, the large-scale pattern should show a reduction in the extent of injury that reflects the distance from the source of pollution, patterns of wind speed and the constancy of wind direction, particularly during the growing season. Small-scale patterns should also reflect the direction and speed of winds from the pollutant source, the density of foliage in the crown of the plant and the existence of obstacles to air movement. The directional pattern of pollutant injury distribution around a plant will be identical with that due to wind effects in the prevailing down-wind direction from the emission source, so it may be extremely difficult to separate pollutant and non-pollutant effects.

Therefore, a careful examination of the distribution of injury around a large plant, such as a tree, is essential, bearing in mind the effects of small-scale ground relief and the conformation of vegetation on the direction and speed of local winds. In these situations, relevant information on the location of foliage should be included. Where such information is not indicated, the injury records relate to general estimates of condition for a complete plant crown or for a group of small plants.

3.5.6 Mimicking Symptoms

The use of plants as biological indicators of pollution requires that the symptoms of pollutant injury can be distinguished from those of other environmental stressors. Several environmental conditions induce visible symptoms similar to those caused by pollutants, so the appearance of a particular category of injury does not necessarily mean that it is due to a pollutant. These include necrosis tip, necrosis marginal, anthrocyanin and cupping. In particular, the effects of drought and storm winds may be very similar to those of fluoride exposure, and chlorosis induced by fluoride may closely resemble symptoms of iron or magnesium deficiency. Insect attack can also cause injury symptoms similar to that of fluoride related injury (chlorosis and anthrocyanin).

3.6 Criteria for Injury Due to Industrial Emissions

Dr Doley (HLA-Envirosciences, 2004 - now AECOM) established the following conditions for attributing foliar injury to emissions from an industrial source, which were followed in this survey:

- The pattern of distribution of injured trees should be consistent with observed or probable patterns of distribution of emissions.
    - Modelled distribution patterns for fluoride under conditions of atmospheric stability and low to moderate wind speed are considered to be the most appropriate comparisons; and
    - The periods of exposure need not be continuous, but there should be sufficient exposure (combination of concentration and exposure duration) to result in the observed injury.
- The degree of injury should be consistent with known or probable exposure of vegetation to pollutants.
    - If fluoride were suspected of being the causal agent, ambient gaseous concentrations greater than 2.0 μg F/m^3 would be required to persist for about one month in species of moderate fluoride tolerance, and greater than 2.0 μg F/m^3 would be required to persist for more than one week in species that were very sensitive to fluoride injury; and
    - Individuals of a species may vary in sensitivity to a pollutant by a factor of 10.
- The distribution of injury within a large plant, such as a tree, should be consistent with probable patterns of distribution of exposure.
    - If the injury had continued for more than one growing season, the degree of injury in foliage should increase progressively with foliage age. Older leaves should show some evidence of injury in each season, commonly as banding or watermarking of zones of injury;
    - If the event resulting in injury occurred only within the current growing season in an evergreen species, current season foliage might be expected to show more injury than older foliage because it would be more exposed (higher boundary layer conductance to gas uptake), and possibly more sensitive to the pollutant; and
    - If the injury was confined to a portion of a single growing season, the pattern of distribution of injury should be consistent with known or probable patterns of release of pollutant during that season.

3.7 Assessment of Commercial Loss

Environmental harm to commercial crops is most appropriately judged on the capacity of the crop to produce a yield of quality of product that is not significantly different from that of a crop maintained under the same environmental conditions and management regime in the absence of a pollutant stress.

Commercial loss may be measured directly if sufficiently detailed records of crop yield are maintained. For small-scale occurrences of injury, a visual inspection method may also be appropriate.

For pollutant-sensitive crop species, there is commonly an association between the extent of loss of functioning of leaf area and the loss of production potential. This association is best expressed where necrosis is the principal symptom, as in grapevines or many grass species. In this situation, not all leaves may be injured, and the degree of injury in affected leaves may vary considerably. A suitable index of injury can be constructed from the product of the percentage of leaves showing injury and the percentage of the area injured in those affected leaves (see expression below). An estimate should be made over a number of plants in order to obtain a crop average, but it may be applied to individual plants where they are sufficiently large.

$$I = N A / 100$$

Where:

I is the percentage of the total crop leaf area affected;

N is the percentage of leaves showing injury; and

A is the percentage of the leaf area injured in the leaves showing injury.

This estimate provides a continuous assessment of injury, unlike the categories used for aesthetic assessment.

3.8 Foliage Fluoride Content Sampling and Analysis

Samples chosen for fluoride content analysis followed similar methodology selected during the background survey (refer to HLA-Envirosciences, 2004 – now AECOM). Vegetation samples were transported to the ALS Newcastle laboratory for analysis.

Sites and species nominated for determination of foliar fluoride concentrations are indicated in Table 6.

Table 6 Sites and trees selected for foliage fluoride content analysis

Site	Location	Species
Site 5	NCIA – South-east corner of premises	*Eucalyptus amplifolia*
Site 11	Hill Top – Wollombi Rd, Farley	Native grasses*
Site 13	NCIA site entrance (outside premises)	*Eucalyptus amplifolia*
		Corymbia maculata
Site 15	11 Gardiner Road, Rutherford industrial estate	*Corymbia maculata*
Site 19	Reference site – Anambah homestead	*Vitis vinifera*

* Native grasses were sampled from a pasture paddock and in general proportion to their representation at the sampling site.

4.0 Vegetation Survey Results

4.1 NCIA Premises

A summary of vegetation condition assessments associated with specimens inspected on the NCIA premises is provided in Table 7. Where possible, a condition assessment of both current season leaves ('foliar age' designated '0') and previous season leaves ('foliar age' designated '1') has been reported, and hence multiple sets of assessment data are presented for individual specimens. Where previous and current season leaves could not be differentiated, a general assessment of the foliage was conducted, and 'foliar age' is designated as 'mixed'.

4.1.1 Site 1 – Access Road North of Office

This site is located close to the entrance of the NCIA premises, around the northern end of the factory shed. Most of the species in this area are native, although not all were endemic to the region. Trees surveyed at this site included one *Acacia longifolia* and three *Eucalyptus robusta* specimens.

Acacia longifolia was in good condition with only very slight chlorosis symptoms recorded and no insect attack injury, which represents an improvement in condition from last year's observations. Reproduction pods were present at the time of survey.

All three *Eucalyptus robusta* surveyed were relatively young trees. The trees generally recorded no sign of emission related injury, with the exception of one specimen which showed slight chlorosis and very slight tip necrosis on previous season leaves. This specimen was the one located to the southern end of Site 1 and therefore closest to the emission stacks and within the dominant south-easterly winds range. Very slight to slight insect attack symptoms were present on all specimens. Only one tree had reproductive buds at the time of survey. Overall, the *Eucalyptus robusta* specimens were in better condition than the previous year, where distinct fluoride symptoms were commonly noted.

4.1.2 Site 2 – Office Car Park

This site is located just outside the NCIA offices. Various staggered plantings have occurred in this area over recent years and all trees are relatively young.

In contrast to last year's slight chlorosis symptoms, the *Fraxinus pennsylvanica* showed no sign of impact, whether emission or insect related.

Similarly, *Eucalyptus robusta* displayed no sign of fluoride impacts and a better condition than during the previous survey. However, this specimen was impacted by insect attack, with previous season leaves showing slight chewing and marked sap sucking, and new leaves starting to display very slight evidence of sap sucking.

The *Eucalyptus botryoides* was the most impacted at this site, with slight chlorosis, cupping, tip necrosis and anthocyanin impacts in old leaves; and distinct chlorosis and slight cupping and tip necrosis in young leaves. All leaves had very slight leaf chewing and slight sap sucking symptoms. These impacts are consistent with last year's for this specimen.

4.1.3 Site 3 – Access Road South of Office

This sampling site consists of trees planted close to the premise's internal road leading to the dispatch dock. The only tree studied during this survey was the *Acacia longifolia*, which appeared in very good condition with no injury recorded.

4.1.4 Site 4 – South-west Corner of Site

Trees in this location are located along the western fence of the premises, along the drainage line. Three specimens were studied, and observations at this site were generally consistent with the results of the 2010 survey.

Very slight chlorosis, leaf chewing and sap sucking were visible in *Acacia fimbriata*, while only very slight chlorosis was recorded for *Bursaria spinosa*.

New season leaves on *Eucalyptus amplifolia* showed no emission related impacts, and very slight insect chewing and sap sucking. Previous season leaves were slightly chlorotic and showed evidence of very slight cupping and

anthocyanin accumulation. Very slight chewing and slight sap sucking were also visible in older leaves. Very slight dieback was present in this tree.

4.1.5 Site 5 – South-east Corner of Site

A mature *Eucalyptus amplifolia* and *Bursaria spinosa* specimens constitute this site (Plate 1).

Coppice shoots of the *Eucalyptus amplifolia* were examined and sampled due to the inaccessibility of upper branches. Both current and previous season leaves were present. New leaves did not appear to be impacted by fluoride, but insect attack injury was obvious with marked leaf chewing and slight sap sucking impacts. Older leaves had similar insect attack injury, and displayed slight anthocyanin accumulation. This may be attributable to the leaves present on the tree being at the end of their growing cycle, rather than emission impact. Very slight branch and canopy dieback was recorded.

The *Bursaria spinosa* shrubs only showed very slight chlorosis symptoms and very slight branch dieback.

Plate 1 View of Site 5, with mature *Eucalyptus amplifolia* and *Bursaria spinosa* shrubs (in the foreground)

Table 7 Summary condition assessment of selected monitoring sites located within the NCIA premises

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 1 – Access road north of office															
Acacia longifolia	**1**	**1**	mixed	1	0	0	0	0	0	0	0	0	0	✓	Along northern fence opposite RSPCA
Eucalyptus robusta 1	**0**	**1**	0	0	0	0	0	0	1	1	0	0	✓	0	North end of shed
	1	**2**	1	0	0	0	0	0	1	2					
Eucalyptus robusta 2	**0**	**2**	0	0	0	0	0	0	2	0	0	0	0	0	Clay shed entry
	1	**2**	1	0	0	0	0	0	2	0					
Eucalyptus robusta 3	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	70 m north of office
	2	**2**	1	2	0	1	0	0	1	1					
Site 2 – Office car park															
Eucalyptus botryoides	**3**	**3**	0	3	2	2	0	0	1	2	0	0	0	0	
	2	**2**	1	2	2	2	0	2	1	2					
Eucalyptus robusta	**0**	**1**	0	0	0	0	0	0	0	1	0	0	0	0	
	0	**4**	1	0	0	0	0	0	2	4					
Fraxinus pennsylvanica	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Site 3 – Access road south of office															
Alaeocarpus sp.	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Acacia longifolia	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Site 4 – South-west corner of site															
Acacia fimbriata	**1**	**1**	mixed	1	0	0	0	0	1	1	0	0	0	0	
Bursaria spinosa	**1**	**0**	mixed	1	0	0	0	0	0	0	0	0	0	0	

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Dianella caerulea	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Eucalyptus amplifolia	**0**	**1**	0	0	0	0	0	0	1	1	1	0	0	0	
	2	**2**	1	2	1	0	0	1	1	2					
Site 5 – South-east corner of site															
Bursaria spinosa	**1**	**1**	mixed	1	0	0	0	0	0	0	1	0	0	✓	
Eucalyptus amplifolia	**0**	**4**	0	0	0	0	0	0	4	2	1	1	0	0	Coppice
	2	**3**	1	0	0	0	0	2	3	2					

4.2 Rutherford Residential Area and Farley

A summary of vegetation condition assessments associated with specimens inspected in the Rutherford and Farley residential areas is provided in Table 8.

4.2.1 Site 6 – 3 Pallisade Street

This site is located on a vacant allotment which contains several *Corymbia maculata* specimens, including few mature trees and several sapling and seedlings.

The *Corymbia maculata* at the front of the block on the roadside showed both current and previous season leaves. Older leaves were visibly more impacted with distinct cupping, slight chlorosis index and very slight tip necrosis. Leaf chewing was very slight and sap sucking was distinct. In contrast, no fluoride impact was evident in younger leaves, even though insect damage was present with very slight chewing and marked sap sucking. This tree also presented very slight signs of branch dieback.

The *Corymbia maculata* located at the back of the block had no new season growth. Cupping and chlorosis were slight in previous season leaves, while very slight tip necrosis was observed (Plate 2). Insect injury was also present, with both chewing (very slight) and sap sucking (slight). Reproductive buds were present.

Overall, the Spotted Gums at this site were in a healthier state than during last year's survey where marked emission related injuries were noted.

Plate 2 Site 6 – *Corymbia maculata* (back of block) leaves showing slight chlorosis and cupping and very slight tip necrosis

4.2.2 Site 7 – Gillette Close

This site consists a vacant block of land that was first observed to be partially cleared and marked for sale in the Quarter 1 2010 survey. It was identified during the Quarter 2 survey that this block of land has now been sold. The selection of a new site in the locality will occur once the block is inaccessible.

Trees surveyed at this site included *Eucalyptus acmenoides* and *Corymbia maculate* specimens, as well as *Lantana camara* that grows through the chain wire fence at the back of the block. The *Bursaria spinosa* specimen, which had previously been mowed down and inaccessible for survey during the 2011 quarterly surveys, has regrown and was assessed for fluoride and insect damage.

New season growth on the *Eucalyptus acmenoides* appeared healthy with no emissions injury. Previous season leaves showed very slight tip necrosis and cupping, and were slightly chlorotic (Plate 3). All leaves suffered from insect attack with distinct leaf chewing and slight sap sucking. The canopy was dense and no dieback was evident. Symptoms related to emission injury were slightly less pronounced this year than during last year's survey. Reproductive buds were present.

New season growth on the *Corymbia maculata* presented very slight cupping but no other signs of fluoride impact. Old leaves displayed a broader range of symptoms with slight chlorosis and cupping and very slight tip and marginal necrosis (Plate 4). Insect leaf chewing was distinct in both new and older leaves, and sap sucking was very slight (new leaves) to slight (old leaves) (Plate 4). Very slight branch dieback was observed. Reproductive buds were present. Overall, this Spotted Gum was in a similar condition than the previous year.

Lantana camara and *Bursaria spinosa* (Plate 5) were healthy with no fluoride or insect injury.

Plate 3 Site 7 – *Eucalyptus acmenoides* leaves with very slight tip necrosis and cupping, and slight chlorosis

Plate 4 **Site 7 – *Corymbia maculata* leaves showing very slight cupping, slight chlorosis and distinct leaf chewing**

Plate 5 **Site 7 – *Bursaria spinosa***

4.2.3 Site 8 – Regiment Road east of Dumont Court

Site 8 is located in a drainage easement in the Rutherford residential area that provides access to several trees, including *Acacia fimbriata*, *Corymbia maculata* and *Eucalyptus resinfera*.

No emission related impact was visible on *Acacia fimbriata*. Very slight leaf chewing, slight sap sucking and slight branch dieback were noted.

No new growth was present in *Corymbia maculata.* Both leaf chewing and sap sucking were slight in previous season leaves. Fluoride impacts consisted of distinctly chlorotic leaves along with very slight cupping and tip necrosis (Plate 6).

The new growth in *Eucalyptus resinfera* had just started to appear. No emission related impacts were visible on this species. Insect leaf chewing was very slight in all leaves, and sap sucking was slight (old leaves) to distinct (new leaves). Reproductive buds were present.

The overall condition of trees at Site 8 was comparable with that of the previous year.

Plate 6 Site 8 – Corymbia maculata leaves showing very slight cupping and tip necrosis, and distinct chlorosis

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

This site is also located in a drainage easement with vegetation accessible on both sides of Squadron Crescent. Species surveyed included *Bursaria spinosa*, *Corymbia maculata* and *Eucalyptus resinfera,* and all appeared in a good condition, which was consistent with last year's records.

The only observable impacts on *Bursaria spinosa* consisted of slight chlorosis (Plate 7) and very slight sap sucking. Flower buds were just starting to appear on this species at the time of survey.

In *Corymbia maculata*, new leaves showed no impact and old leaves only suffered from very slight leaf chewing.

New growth in *Eucalyptus resinfera* was very new. Leaf chewing and sap sucking symptoms were very slight in all leaves, and previous season leaves displayed very slight tip necrosis. Very slight branch dieback was visible, and reproductive buds were present.

Plate 7 Site 9 – *Bursaria spinosa* leaves displaying slight chlorosis symptoms

4.2.5 Site 10 – Wollombi Road between sewage works and creek

Site 10 is located on Wollombi Road just north of the railway crossing and along the creek line. Species surveyed include *Fraxinus excelsior*, *Grevillea robusta*, *Pinus radiata* and *Populus nigra* var. *Italica*.

Despite being sensitive species, *Fraxinus excelsior* (Plate 8) and *Populus nigra* var. *Italica* (Plate 9) displayed no symptoms of emission related injury and were generally in a healthy condition, with no or only very slight insect damage in the case of the Poplar tree.

Similarly, *Grevillea robusta* (Plate 10) and *Pinus radiata* showed no injury.

Plate 8 **Site 10 – *Fraxinus excelsior***

Plate 9 **Site 10 – *Populus nigra* var. *Italica***

Plate 10 Site 10 – *Grevillea robusta* leaves

4.2.6 Site 11 – Hill top on Wollombi Road west of Owl Pen Lane, Farley

A sample of grasses along the road side at Wollombi Rd was taken containing a mixture of couch and tussock species, with shoots pulled at a height judged to be that to which cattle would graze, avoiding inclusion of soil. The fluoride analysis of this grass sample is discussed in Section 4.6.

The condition of the species *Acacia baileyana*, *Bursaria spinosa*, *Corymbia maculata* and *Eucalyptus moluccana* was visually assessed. The *Hakea gibbosa* specimen that was part of last year's survey protocol for this site could not be located. The shrub may have been mowed down or grazed/trampled by stock.

The *Acacia baileyana* was a very young sapling (Plate 11) that showed no sign of impact. Although *Bursaria spinosa* foliage displayed no fluoride or insect injury, the shrub was in poor condition with some branch dieback resulting from recent roadside maintenance activities.

Previous season leaves in *Corymbia maculata* had a distinct chlorosis index, slight anthocyanin accumulation and very slight cupping and necrosis (both tip and marginal) (Plate 12). Young leaves however did not give apparent signs of fluoride impacts. Slight chewing and sap sucking was present on all leaves. The condition of this tree as observed during this surveyed has worsened from last years and previous quarters observations where no fluoride impacts were detected.

Eucalyptus moluccana displayed no sign of emission related injury but for slight anthocyanin accumulation in previous season leaves, which can likely be attributed to the leaves being at the end of their growing cycle. Insect damage was present on all leaves with slight chewing and sucking in young leaves and marked chewing and slight sucking in old leaves. Slight branch dieback was evident but canopy was healthy. This tree was healthier than in previous surveys where fluoride impacts were evident.

Plate 11 **Site 11 – *Acacia baileyana***

Plate 12 **Site 11 – *Corymbia maculata* leaves showing chlorosis, necrosis and chewing**

4.2.7 Site 12 – Western end of Quarry Road, Farley

Site 12 is located approximately 2.2 km south of the NCIA plant. The condition of the species *Corymbia maculata* (Plate 13), *Eucalyptus paniculata* (Plate 14) and *Pinus radiata* was visually assessed.

Neither species appeared affected by fluoride emissions at this location, reflecting the distance to the emission stacks and the location of the site outside the prevailing winds pattern. Only *Corymbia maculata* had very slight tip necrosis, which given the healthy state of all surrounding vegetation can likely not be attributed to fluoride. Emission injury was generally in accordance with previous seasons' observations at the site, apart for *Corymbia maculata* for which necrosis and anthocyanin accumulation were more evident last year.

Insect attack was present in the Gum trees, with slight or distinct symptoms in *Corymbia maculata* (Plate 15) and very slight or slight symptoms in *Eucalyptus paniculata*. Buds were present on *Eucalyptus paniculata.*

Plate 13 **Site 12 – *Corymbia maculata***

Plate 14 **Site 12 – *Eucalyptus paniculata***

Plate 15 Site 12 – *Corymbia maculata* leaves showing chewing and sap sucking damage

Table 8 Summary condition assessment of selected monitoring sites located in the Rutherford and Farley residential areas

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 6 – 3 Palisade Street															
Corymbia maculata 1	**0**	**4**	0	0	0	0	0	0	1	4	1	0	0	0	Front of the allotment (roadside)
	3	**3**	1	2	3	1	0	0	1	3					
Corymbia maculata 2	**-**	**-**	0	-	-	-	-	-	-	-	0	0	✓	0	Back of the allotment
	2	**2**	1	2	2	1	0	0	1	2					
Site 7 – Gillette Close															
Eucalyptus acmenoides	**0**	**3**	0	0	0	0	0	0	3	2	0	0	✓	0	
	2	**3**	1	2	1	1	0	0	3	2					
Bursaria spinosa	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Corymbia maculata	**0**	**3**	0	0	1	0	0	0	3	1	1	0	✓	0	
	2	**3**	1	2	2	1	1	0	3	2					
Lantana camara	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Site 8 – Regiment Road east of Dumont Court															
Acacia fimbriata	**0**	**2**	mixed	0	0	0	0	0	1	2	2	0	0	0	
Corymbia maculata	**-**	**-**	0	-	-	-	-	-	-	-	0	0	0	0	
	3	**3**	1	3	1	1	0	0	2	2					
Eucalyptus resinfera	**0**	**3**	0	0	0	0	0	0	1	3	0	0	✓	0	
	0	**2**	1	0	0	0	0	0	1	2					

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 9 – Regiment Road south-east of Squadron Crescent															
Bursaria spinosa	**2**	**2**	mixed	2	0	0	0	0	0	1	0	0	0	✓	
Corymbia maculata	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	
	0	**1**	1	0	0	0	0	0	1	0					
Eucalyptus resinfera	**0**	**1**	0	0	0	0	0	0	1	1	1	0	✓	0	
	1	**1**	1	0	0	1	0	0	1	1					
Site 10 – Wollombi Road between sewage works and creek															
Fraxinus excelsior	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	✓	
Grevillea robusta	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Pinus radiata	**0**	**1**	mixed	0	0	0	0	0	0	0	1	0	0	0	
Populus nigra var. *Italica*	**0**	**2**	mixed	0	0	0	0	0	1	1	2	0	0	0	
Site 11 – Hill top on Wollombi Road west of Owl Pen Lane, Farley															
Acacia baileyana	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Bursaria spinosa	**0**	**2**	mixed	0	0	0	0	0	0	0	3	0	0	✓	
Hakea gibbosa	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Corymbia maculata	**0**	**2**	0	0	0	0	0	0	2	1	1	0	0	0	
	3	**3**	1	3	1	1	1	2	2	2					
Eucalyptus moluccana	**0**	**2**	0	0	0	0	0	0	2	2	2	0	0	0	
	0	**4**	1	0	0	0	0	2	4	2					

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 12 – Western end of Quarry Road, Farley															
Corymbia maculata	**0**	**3**	0	0	0	0	0	0	3	2	1	0	0	0	
	1	**2**	1	0	0	1	0	0	2	1					
Eucalyptus paniculata	**0**	**1**	0	0	0	0	0	0	1	1	0	0	✓	0	
	0	**2**	1	0	0	0	0	0	2	1					
Pinus radiata	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	

4.3 Rutherford Industrial Estate

Industrial properties adjoin the NCIA premises to the northwest, so the vegetation available for assessment is that growing on or overhanging the road reserves. This vegetation consists of native trees and, in some locations, planted tree and shrub species. The security of this vegetation cannot be guaranteed, so sampling is regarded as opportunistic. A summary of vegetation condition assessments associated with specimens inspected in the Rutherford Industrial Area is provided in Table 9.

4.3.1 Site 13 – NCIA entrance, Racecourse Road

Corymbia maculata and *Eucalyptus amplifolia* were selected for both visual and foliar fluoride sampling (Plate 16).

The lower branches of *Corymbia maculata* continued to support a mistletoe infestation, and the tree presented very slight branch dieback. The current season leaves showed slight chlorosis and very slight cupping, as well as very slight chewing and sap sucking. Symptoms of injury were more pronounced in previous season leaves, which displayed a distinct chlorosis index, slight tip necrosis and very slight cupping and marginal necrosis (Plate 17). Insect attack on old leaves was slight (chewing) to distinct (sap sucking). Reproductive buds were present.

Eucalyptus amplifolia proved less sensitive with current season leaves showing no emission impact, and current season leaves only having very slight tip necrosis. All leaves were very slightly chewed by insects and sap sucking was slight. Reproductive buds were present.

The condition of trees at this site was comparable to last year's.

Plate 16 View of Site 13, showing *Corymbia maculata* and *Eucalyptus amplifolia*

Plate 17 Site 13 – *Corymbia maculata* leaves with distinct chlorosis and slight cupping

4.3.2 Site 14 – 100-104 Kyle Street

Angophora floribunda and *Eucalyptus amplifolia* were visually assessed for fluoride injury symptoms. Symptoms usually concurred with those observed in the previous survey.

Young leaves in *Angophora floribunda* were free of fluoride impact symptoms but insect damage was evident, with very slight chewing and marked sap sucking. Fluoride impacts in older leaves were very slight (cupping, tip necrosis, anthocyanin) to slight (chlorosis) (Plate 18), and both insect chewing and sap sucking were slight. This tree was infested with mistletoes.

Eucalyptus amplifolia only displayed very slight symptoms of emission related impacts, including chlorosis in current season leaves and tip necrosis in all leaves. Insect damage was very slight to slight in all leaves. Both flowers and reproductive buds were present on the tree.

Plate 18 Site 14 – Angophora floribunda leaves showing very slight cupping, tip necrosis and anthocyanin, and slight chlorosis

4.3.3 Site 15 – 11 Gardiner Road

Corymbia maculata and *Eucalyptus fibrosa* were visually assessed for fluoride impacts (Plate 19). Leaves of *Corymbia maculata* were collected for foliar fluoride sampling.

Corymbia maculata was observed to have a similar moderate health as noted in the previous survey. New season leaves showed distinct chlorosis and tip necrosis, slight cupping and were very slightly impacted by sap sucking insects. The leaves from the previous season had very slight signs of chlorosis, cupping, tip and marginal necrosis, leaf chewing and sap sucking.

Eucalyptus fibrosa appeared in a similar good health as observed in the previous survey. Insect damage on all leaves was very slight (chewing) to slight (sap sucking). Fluoride did not affect young leaves and only slight tip necrosis was observed in older leaves. Reproductive buds were present.

Plate 19 View of Site 15, with Corymbia maculata (left) and Eucalyptus fibrosa (right)

4.3.4 Site 16 – 56 Gardiner Road

A *Corymbia maculata* supporting a mistletoe infestation was assessed at Site 16. No new season growth was present on this specimen and only previous season leaves were assessed. Overall, the scale of injury was similar to that of the previous survey. Previous season leaves were distinctly chlorotic with very slight cupping and tip necrosis (Plate 20). Insect damage was observed to be very slight for leaf chewing and slight for sap sucking.

Plate 20 Site 16 – *Corymbia maculata* foliage showing distinct chlorosis and very slight cupping and tip necrosis

4.3.5 Site 17 –Gardiner Road, Southern end

Species assessed at this site included *Corymbia maculata*, *Eucalyptus paniculata* and *Eucalyptus punctata*.

Both seasons leaves in *Corymbia maculata* displayed identical emission injury symptoms with only very slight tip necrosis being present. Symptoms associated with insect attack were very slight in old leaves and slight in young leaves.

Eucalyptus paniculata was in good condition and showed no symptom of emission injury. The only injury recorded consisted of very slight insect leaf chewing in both previous and current seasons leaves. Reproductive buds were present on the tree.

All foliage in *Eucalyptus punctata* was very slightly chlorotic. Tip necrosis was observed in both new leaves (very slight) and old leaves (slight). Symptoms of insect injury were very slight to slight. Very slight branch dieback was observed. Reproductive buds were present.

Overall, tree specimens at Site 17 were in slightly better condition than during the previous year survey with less severe fluoride related impacts.

4.3.6 Site 18 – Maitland Saleyards, Kyle Street

At the entrance to the saleyards, light to medium density vegetation exists, comprising multiple *Corymbia maculata*, *Eucalyptus amplifolia, Eucalyptus moluccana,* and *Eucalyptus paniculata*.

The new season growth on the *Corymbia maculata* individuals was generally more injured than older leaves, with marked cupping, severe insect sap sucking, and very slight tip necrosis and leaf chewing. It is possible that the marked cupping observed in young leaves is in response to the severe insect damage they were subject to rather than fluoride effects. Previous season leaves only displayed slight tip necrosis, very slight cupping and very slight insect damage (Plate 21). Reproductive buds were present. The health of these specimens was overall fairly poor and has deteriorated from the previous survey where no fluoride impact was noted and sap sucking insect damage was absent.

Emission related impacts were all very slight on the *Eucalyptus amplifolia.* Symptoms included tip necrosis in current season leaves; and chlorosis and tip necrosis in previous season leaves. In all leaves chewing was very slight and sap sucking was slight. Slight branch dieback and slight canopy damage were observed. Although still

in relatively good condition, *Eucalyptus amplifolia* seemed on a deteriorating trend as no fluoride impacts were observed last year.

The *Eucalyptus moluccana* was observed to be in a similar condition than during the previous survey. No emission related impacts were evident in new leaves, whilst very slight chlorosis and anthocyanin accumulation were recorded in old leaves. Leaf chewing was distinct in all leaves, and sap sucking was slight or very slight.

The *Eucalyptus paniculata* at the site is a large individual in very poor condition with severe dieback and severely damaged canopy (Plate 22). All previous season leaves were in the canopy and too elevated to be surveyed; therefore only current season leaves from a sprout at the base of the tree were able to be assessed. Young leaves observed only showed very slight anthocyanin accumulation but no other fluoride impact. Leaves also distinctively suffered from insect chewing and sap sucking. The condition of this tree has been consistently poor over the last quarterly and annual surveys.

Plate 21 Site 18 – *Corymbia maculata* leaves showing slight tip necrosis, very slight cupping and very slight insect damage

Plate 22 Site 18 – *Eucalyptus paniculata*

Table 9 Summary condition assessment of selected monitoring sites located in the Rutherford Industrial Area

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 13 – NCIA entrance, Racecourse Road															
Corymbia maculata	**2**	**2**	0	2	1	1	0	0	1	1	1	0	✓	0	Mistletoe infestation
	3	**3**	1	3	1	2	1	0	2	3					
Eucalyptus amplifolia	**0**	**2**	0	0	0	0	0	0	1	2	0	0	✓	0	
	0	**2**	1	0	0	0	0	0	1	2					
Site 14 – 100-104 Kyle Street															
Angophora floribunda	**0**	**4**	0	0	0	0	0	0	1	4	0	0	0	0	Mistletoe infestation
	2	**2**	1	2	1	1	0	1	2	2					
Eucalyptus amplifolia	**1**	**1**	0	1	0	1	0	0	1	2	1	1	✓	✓	
	2	**2**	1	0	0	1	0	0	2	1					
Site 15 – 11 Gardiner Road															
Corymbia maculata	**3**	**3**	0	3	2	3	0	0	0	1	0	0	0	0	
	1	**1**	1	1	1	1	1	0	1	1					
Eucalyptus fibrosa	**0**	**1**	0	0	0	0	0	0	1	1	0	1	✓	0	
	2	**2**	1	0	0	2	0	0	1	2					
Site 16 – 56 Gardiner Road															
Corymbia maculata	**-**	**-**	0	-	-	-	-	-	-	-	0	0	✓	0	Mistletoe infestation
	3	**3**	1	3	1	1	0	0	1	2					

Site/Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Site 17 – Gardiner Road, Southern end															
Corymbia maculata	**1**	**2**	0	0	0	1	0	0	2	2	0	0	0	0	
	1	**1**	1	0	0	1	0	0	1	1					
Eucalyptus paniculata	**0**	**1**	0	0	0	0	0	0	1	0	0	0	✓	0	
	0	**1**	1	0	0	0	0	0	1	0					
Eucalyptus punctata	**1**	**2**	0	1	0	1	0	0	1	2	1	0	✓	0	
	2	**2**	1	1	0	2	0	0	1	1					
Site 18 – Maitland Saleyards, Kyle Street															
Corymbia maculata	**4**	**5**	0	0	4	1	0	0	1	5	0	0	✓	0	
	2	**2**	1	0	1	2	0	0	1	1					
Eucalyptus amplifolia	**1**	**1**	0	0	0	1	0	0	1	1	2	2	0	0	
	1	**2**	1	1	0	1	0	0	2	2					
Eucalyptus moluccana	**0**	**3**	0	0	0	0	0	0	3	1	0	0	0	0	
	1	**3**	1	0	0	0	0	1	3	2					
Eucalyptus paniculata	**0**	**5**	0	0	0	0	0	1	3	3	5	5	0	0	Old leaves not accessible to survey
	-	**-**	1	-	-	-	-	-	-	-					

4.4 Reference Site – Anambah Homestead

Results of the visual assessment for the reference monitoring site located at Anambah Homestead are described in Table 10.

A broad diversity of species is assessed at this site. The site is located approximately 3 km to the north of the NCIA plant thus outside the prevailing wind direction. Being a reference site, no or very little effect of fluoride emissions is expected to impact the vegetation, and if a score is generated for a species, the link to fluoride emission as a cause for the symptom cannot be ascertained. Indeed, a range of other factors such as stress, climatic conditions or diseases may cause vegetation to exhibit similar symptoms.

The vegetation at the site was in good condition, consistently with observations of previous surveys. It is noted that significant clean-up (tree pruning, lopping, mowing, etc.) of the site has been undertaken since the last survey.

Vine leaves (Plate 23) in the upper block showed slight signs of anthocyanin accumulation. Leaves in the lower block displayed very slight necrosis of the tips and margins. All other species showed no sign of emission related injury. Insect damage was present in most specimens but only to a very slight or slight degree.

Several species were fruiting or flowering at the time of survey. The Radiata Pines were the least healthy trees with distinct branch dieback and distinct damage to canopy.

Plate 23 Site 19 – *Vitis vinifera*

Table 10 Summary condition assessment of selected tree species at Anambah Homestead (reference site)

Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Reference Site – Anambah Homestead															
Vitis vinifera upper block	**2**	**2**	mixed	0	0	0	0	2	1	1	-	-	-	✓	
Vitis vinifera lower block	**1**	**1**	mixed	0	0	1	1	0	1	1	-	-	-	✓	
Angophora costata	**0**	**1**	mixed	0	0	0	0	0	1	1	0	0	0	✓	
Araucaria cunninghamii	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	0	
Brachychiton acerifolius	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Brachychiton populnea	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Casuarina torulosa	**0**	**1**	mixed	0	0	0	0	0	0	0	1	0	0	✓	
Corymbia citriodora	**0**	**2**	mixed	0	0	0	0	0	1	0	1	2	0	0	
Corymbia maculata	**0**	**1**	mixed	0	0	0	0	0	1	1	1	0	0	0	
Eucalyptus acmenoides	**0**	**2**	mixed	0	0	0	0	0	1	2	1	0	✓	0	
Eucalyptus amplifolia	**0**	**1**	mixed	0	0	0	0	0	1	1	1	0	0	0	
Eucalyptus dives	**0**	**2**	mixed	0	0	0	0	0	2	1	0	0	✓	0	
Eucalyptus grandis	**0**	**1**	mixed	0	0	0	0	0	1	1	1	0	0	0	
Eucalyptus robusta	**0**	**1**	mixed	0	0	0	0	0	1	1	1	0	✓	0	

Species	Emissions injury	Total injury	Foliar age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction – buds	Reproduction – fruit	Comments
Ficus macrophylla	**0**	**1**	mixed	0	0	0	0	0	1	1	0	1	0	✓	Significant leaf shedding
Grevillea robusta	**0**	**2**	mixed	0	0	0	0	0	1	2	1	0	0	0	
Lophostemon confertus	**-**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	Not surveyed
Macadamia integrifolia	**0**	**1**	mixed	0	0	0	0	0	0	1	0	0	0	✓	
Olea europea	**0**	**0**	mixed	0	0	0	0	0	0	0	0	0	0	✓	
Pinus radiata	**0**	**3**	mixed	0	0	0	0	0	0	0	3	3	0	✓	

4.5 Comparison of Injury Expression – 2003 - 2011

Table 11 summarises the seasonal variation in visible injury expression in fluoride-sensitive tree species at three locations (Sites 5, 7 & 15), with data based on monitoring events from 2003-2011 inclusive where available. As a function of the variability in seasonal development in different years, one-year-old foliage has been used for the comparisons where possible.

Table 11 Annual comparison of visible injury expression in one-year-old foliage from selected tree species in the Rutherford area

Site	Year of Survey / Species	Emissions injury	Total injury	Leaf age yrs	Chlorosis index	Cupping index	Necrosis tip index	Necrosis marginal index	Anthocyanin index	Leaf chewing index	Sap sucking index	Branch dieback	Crown density	Reproduction - buds	Reproduction - fruit
5	**NCIA monitor site - *Eucalyptus amplifolia***														
	2007	2	2	0	2	0	0	0	0	2	0	0	0	✓	✓
	2008	0	5	1	0	0	0	0	3	4	2	0	0	0	0
	2009	0	4	1	0	0	0	0	3	4	2	0	0	0	0
	2010	2	3	1	0	0	2	0	3	3	0	0	0	0	0
	2011	**2**	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**2**	**1**	**0**	**0**	**0**
7	**Gillette Close - *Corymbia maculata***														
	2003	0	2	1	0	0	0	0	0	2	0	0	0	0	0
	2004	0	1	1	0	0	0	0	0	1	0	0	0	0	0
	2005	0	3	1	0	0	0	0	0	3	2	0	0	0	0
	2006	0	3	1	0	0	0	0	2	3	0	0	0	0	0
	2007	0	2	1	0	0	2	0	2	2	0	0	0	0	✓
	2008	3	3	0	3	0	0	0	0	2	3	0	0	0	0
	2009	3	3	1	3	0	2	1	3	3	3	0	2	0	0
	2010	3	3	1	3	0	2	1	3	3	3	0	2	0	0
	2011	**2**	**3**	**1**	**2**	**2**	**1**	**1**	**0**	**3**	**2**	**1**	**0**	✓	**0**
15	**11 Gardiner Road - *Corymbia maculata***														
	2003	0	2	1	0	0	0	0	0	2	2	0	0	0	0
	2004	0	2	1	1	0	1	0	0	2	1	0	0	0	✓
	2005	0	3	1	0	0	0	0	0	3	2	0	0	0	0
	2006	0	3	1	0	0	2	0	3	3	0	0	0	0	✓
	2007	2	3	1	2	0	2	0	3	3	0	0	0	0	0
	2008	2	4	1	4	0	3	2	3	3	3	0	2	0	✓
	2009	3	3	1	3	2	3	0	2	3	2	0	0	0	0
	2010	3	3	1	3	2	3	0	0	3	1	0	0	0	✓
	2011	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**0**

4.6 Foliar Fluoride Concentrations

Results of the fluoride content analyses are summarised in Table 12, with sampling locations shown in Figure 1. For comparative purposes, historical vegetation fluoride levels for the 2004-2011 annual surveys are provided. Where possible, a mixed sample of current and previous season leaves were collected for analysis. Where current season foliage was too new or absent, only previous season leaves were sampled.

Analytical Laboratory Certificates and chain of custody documentation are presented in Appendix A.

Table 12 Analytical results of fluoride content in vegetation for 2011 and previous annual surveys

Site	Species Sampled	Sample Age	Fluoride Level (µg/g)*							
			Nov 04	Feb 06	Nov 06	Feb 08	Feb 09	Jan 10	Dec 10	Dec 11
5	*Eucalyptus amplifolia*	0	-	-	-	22	-	-	31.6	-
		1	-	-	-	63	11	58.8	-	-
		Mixed	-	-	-	-	-	-	-	**20.8**
11	Native Grasses	1	<10	<1	11	7	10	10	<10	**<10**
13	*Eucalyptus amplifolia*	0	-	-	-	111	22	-	54.1	-
		1	-	-	-	132	-	150	-	-
		Mixed	-	-	-	-	-	-	-	**114**
	Corymbia maculata	0	-	-	-	33	<10	<10	<10	-
		1	-	-	-	-	-	24.6	-	-
		Mixed	-	-	-	-	-	-	-	**13.5**
15	*Corymbia maculata*	0	12	-	21	45	12	19	16.8	-
		1	-	-	40	103	73	75	-	-
		Mixed	12	2	-	-	-	-	-	**48.9**
19	*Vitis vinifera*	Mixed	<10	<1	3	6	<10	15	<10	**<10**

* µg/g are equivalent to mg/kg (as reported in the laboratory certificate of analysis)
- indicates no sample was taken

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5.0 Discussion

5.1 Vegetation Condition

5.1.1 Distribution of Emission Injury

The distribution of injury in both current season and one year old foliage indicates a correlation between emission injury and proximity to the NCIA stacks. The data indicate the extension of the zones of impact towards the northwest and south-east from the centre of the site, which is consistent with the kiln stack being the principal source of fluoride emissions and the occurrence of prevailing south-easterly winds during the growing season for fluoride-sensitive species of *Eucalyptus.*

Injury Category 2 (between 2 and 5 per cent of target leaf area) could be detected on level ground up to 0.9 km north-west from the kiln stack in the vicinity of the Maitland Saleyards (Site 18), and up to 1.8 km to the south-east at Site 9.

Category 3 injury (between 5 and 10 per cent of target leaf area) was observed up to 500m to the north-west of the emission source at Site 15 and as far as 1.5 km to the south-east at Site 8.

During this 2011 survey, the limit of impact from fluoride appeared to be within 2 km of the emission source, as no emission related injury was observed in trees located at Site 10. Likewise, vegetation located outside the prevailing winds at Site 12 showed no sign of fluoride impact.

5.1.2 Insect Damage

The extent of leaf-chewing and sap sucking insect injury generally ranged from very slight to distinct. The occurrence and prevalence of insect attack appeared to be random and no pattern between location, species or foliage age could be established. However, at most sites insect attack constituted the dominant cause of injury to foliage.

5.2 Comparison of Injury Expression – 2003 - 2011

Overall, emission and total injury to foliage is relatively consistent on the long term based on data from the previous annual surveys. However, the 2011 results show a slight improvement in health condition for the three specimens studied (Table 11). It is possible that the above average rainfall observed in the area in the winter and spring of 2011 have contributed to extensive foliage growth and positive tree and shrub health.

The *Eucalyptus amplifolia* at Site 5 has been suffering comparable emission related injuries over the last few years, with very slight to slight symptoms. However with only very slight impacts, insect damage was less severe in 2011 than in previous years where distinct and marked symptoms were consistent on that tree.

Between 2003 and 2006, the *Corymbia maculata* at Site 7 did not appear affected by fluoride symptoms. The health of this tree apparently started to deteriorate in 2007 and it had consistently been showing slight to distinct necrosis and chlorosis symptoms ever since. The 2011 survey revealed an improvement in the emission related injury from ‘distinctly impacted’ in the previous three years to ‘slightly impacted’.

The *Corymbia maculata* at Gardiner Road (Site 15) was in better condition than observed in the previous surveys. It exhibited only very slight symptoms of injuries whilst distinct and marked symptoms were present in the previous years.

5.3 Foliar Fluoride Concentrations

The native grasses at Wollombi Road and the vine leaves at Anambah Homestead both recorded fluoride content of less than 10 µg/g. This low concentration is consistent with the long term trend for these species over the last seven years.

Fluoride content in the leaves of *Eucalyptus amplifolia* at Site 5 was of 20.8 µg/g, which is in the lower range of values recorded in the previous years. In contrast, the foliage of *Eucalyptus amplifolia* located at Site 13 was more than five times as chlorotic (113 µg/g). This elevated concentration is comparable to previous years’ values for this tree. Both these trees are located within close proximity of the kiln stack where atmospheric fluoride is emitted, however the marked difference in fluoride leaf content reflect the location of the trees in relation to the prevailing winds during the growing season, the specimen in the north-west (Site 13) being exposed to the winds during this season.

The *Corymbia maculata* at Site 13 has traditionally shown low levels of fluoride in its foliage, which was perpetuated this year with a concentration of 13.5 µg/g.

At Site 15, *Corymbia maculata* returned a foliage fluoride content of 48.9 µg/g which is in the lower range (yet consistent) of values observed in the last six years. Prior to that, fluoride concentration in this tree were significantly lower.

6.0 Conclusions

The field based visual assessment and laboratory based analyses recorded fluoride emissions impacts that were comparable to the previous surveys and were within the low to medium range of data so far obtained by this monitoring programme.

It was noted that some vegetation appeared in a slightly healthier condition than that observed in the previous surveys. This may be linked to the above average rainfall observed in winter and spring 2011, resulting in extensive foliage growth and positive tree and shrub health.

Emissions related injury can be mimicked by natural environmental impacts such as climatic conditions and insect attack. Insect attack was evident at most locations.

Elevated regional background fluoride concentrations are found in air within the Lower Hunter Region. As a result, foliar fluoride concentrations in the vicinity of NCIA may be influenced by the elevated background fluoride concentration. The existing sampling regime provides an acceptable data set that may, over time, together with other data sets which relate to other fluoride source points indicate any long term trends in fluoride emissions impacts in the local area.

The locations sampled are based on the modelling in the EIS (Parsons Brinkerhoff 2002) and an understanding of the prevailing meteorological conditions. The specimens chosen to be sampled for foliar fluoride content were selected by Dr David Doley for their sensitivity to plant fluoride interactions. It is noted that one of the sampling site (Site 7) may no longer be accessible for future surveys as the block of land on which it is located has been sold for development. A new site will need to be selected in the locality to replace Site 7 once it becomes inaccessible.

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7.0 References

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Appendix A

2011 Analytical Laboratory Documentation

Appendix A 2011 Analytical Laboratory Documentation

ALS Group
Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EN1104198**	Page	: 1 of 4
Client	: **AECOM Australia Pty Ltd**	Laboratory	: Environmental Division Newcastle
Contact	: MR MATTHIEU CATTEAU	Contact	: Peter Keyte
Address	: 17 WARABROOK BOULEVARDE PO BOX 73, HUNTER REGION MC NSW 2310 WARABROOK NSW, AUSTRALIA 2304	Address	: 5 Rosegum Road Warabrook NSW Australia 2304
E-mail	: matthieu.catteau@aecom.com	E-mail	: peter.keyte@als.com.au
Telephone	: +61 02 4911 4900	Telephone	: 61-2-4968-9433
Facsimile	: +61 02 4911 4999	Facsimile	: +61-2-4968 0349
Project	: 60221951	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 60221951		
C-O-C number	: ----	Date Samples Received	: 14-DEC-2011
Sampler	: AECOM	Issue Date	: 23-DEC-2011
Site	: ----		
		No. of samples received	: 6
Quote number	: ----	No. of samples analysed	: 6

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Peter Keyte	Newcastle Manager	Newcastle

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 insuffient 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.

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

Analytical Results

Sub-Matrix: **VEGETATION**

Compound	CAS Number	LOR	Unit	Client sample ID	GRASS SITE 11 WLOOMBI RD	E. AMPLIFOLIA SITE 5	E. AMPLIFOLIA SITE 13	C. MACULATA SITE 13	C. MACULATA SITE 15
				Client sampling date / time	13-DEC-2011 14:00	13-DEC-2011 14:00	13-DEC-2011 14:00	13-DEC-2011 14:00	13-DEC-2011 14:00
					EN1104198-001	EN1104198-002	EN1104198-003	EN1104198-004	EN1104198-005
EK040V: Fluoride in Vegetation									
Fluoride	16984-48-8	10.0	mg/kg		<10.0	**20.8**	**114**	**13.5**	**48.9**

Analytical Results

Sub-Matrix: **VEGETATION**				Client sample ID	**VITIS VINIFERA SITE 19**	----	----	----	----
				Client sampling date / time	13-DEC-2011 14:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EN1104198-006**	**----**	**----**	**----**	**----**
EK040V: Fluoride in Vegetation									
Fluoride	16984-48-8	10.0	mg/kg		<10.0	----	----	----	----

CHAIN OF CUSTODY DOCUMENTATION

AECOM

CLIENT: AECOM

POSTAL ADDRESS: PO BOX 73 HRMC NSW 2310

SEND REPORT TO: Matthieu Catteau

SEND INVOICE TO: Matthieu Catteau

DATA NEEDED BY: 7-days

REPORT NEEDED BY: 7-days

PROJECT ID: 60221951

QUOTE NO.:

P.O. NO.: 60221951

COMMENTS/SPECIAL HANDLING/STORAGE OR DIPOSAL:

FOR LAB USE ONLY
COOLER SEAL
Yes ..... No .....
Broken ..... Intact .....
COOLER TEMP: deg.C

LABORATORY BATCH NO.:

SAMPLERS: AECOM

PHONE: 02 4911 4823 FAX: 02 4911 4999 E-MAIL: Matthieu.Catteau@aecom.com

REPORT FORMAT: HARD: FAX: E-MAIL: ✔

ANALYSIS REQUIRED

SAMPLE DATA					*CONTAINER DATA			Fluoride (µgF/g; dry)	NOTES
SAMPLE ID		MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.	pH		
Grass Site 11 - Wloombi Rd	1	Grass	14-Dec-11		Brown Paper Bag			✔	
E. Amplifolia Site 5	2	Leaves	14-Dec-11		Brown Paper Bag			✔	
E. Amplifolia Site 13	3	Leaves	14-Dec-11		Brown Paper Bag			✔	
C. Maculata Site 13	4	Leaves	14-Dec-11		Brown Paper Bag			✔	
C. Maculata Site 15	5	Leaves	14-Dec-11		Brown Paper Bag			✔	
Vitis vinifera Site 19	6	Leaves	14-Dec-11		Brown Paper Bag			✔	

Environmental Division
Newcastle
Work Order
EN1104198

Telephone : +61-2-4968 9433

RELINQUISHED BY:

NAME : Matthieu Catteau DATE: 14/12/11
OF: AECOM TIME: 9.30 AM
NAME : DATE:
OF: TIME:

RECEIVED BY

NAME : DATE: 14/12
OF: ARS TIME: 9-30
NAME : DATE:
OF: TIME:

METHOD OF SHIPMENT
CONSIGNMENT NOTE NO.
TRANSPORT CO. NAME.

*Container Type and Preservative Codes: P = Neutral Plastic; N = Nitric Acid Preserved; C = Sodium Hydroxide Preserved; J = Solvent Washed Acid Rinced Jar; S = Solvent Washed Acid Rinced Glass Bottle;
VC = Hydrochloric Acid Preserved Vial; VS = Sulfuric Acid Preserved Vial; BS = Sulfuric Acid Preserved Glass Bottle; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle;
O = Other.

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Appendix E

Stack Emission Testing Results

Appendix E Stack Emission Testing Results

Table E1 Summary Particulate Emission Monitoring Results, August and September 2011

Stack	Fine Particulate (PM_{10}) (mg/m^3)	Total Particulate (mg/m^3)	Regulatory Limit (mg/m^3)*
Clay Preparation (CP1) (EPL 1)	<0.13	1.7	20
Pressing and Drying (PD1) (EPL 2)	1.4	8.6	20
Dryer (D1) (EPL 5)	0.74	2.4	20
Dryer (D2) (EPL 6)	<0.3	0.82	20
Glaze Line (EPL 9)	<0.2	<0.22	20
Selection Line (SL 1,2,3,4) (EPL 10)	<0.13	0.19	20
Spray Dryer (SD1) (EPL 10)	1.4	7.9	20
Hot Air Cooler (HAC 1) (EPL 18)	<0.19	2.7	5
Hot Air Cooler (HAC 2) (EPL 19)	<0.36	<0.83	5

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

Table E2 Kiln 1 and Kiln 2 Emission Monitoring Results Summary, August and September 2011

Pollutant	Kiln 1 (EPL 14)	Kiln 2 (EPL 15)	Regulatory Limit
Fine Particulate (at 18% O_2) (PM_{10}) (mg/m^3)	<0.12	0.024	N/A
Total Particulate (at 18% O_2) (mg/m^3)	<0.1	0.044	20
Total Fluoride (as HF) (mg/m^3)	0.58	0.19	5
Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	1.7	6.7	100
Sulfur Dioxide (SO_2 as SO_3) (mg/m^3)	81	93	NA
Total Hazardous Substances (Metals) (mg/m^3)	0.12	0.1	1
Total Oxides of Nitrogen (at 18% O_2) (as Equivalent NO_2) (mg/m^3)	68	69	100
Cadmium (mg/m^3)	0.0042	0.0013	0.1
Mercury (mg/m^3)	0.0069	0.0062	0.1

Table E3 Fine Particulate (PM_{10}) Calculate Aerodynamic Cut Size (D_{50}) Results

Emission Source	Calculated Aerodynamic Cut Size (D_{50}) (μm)
Clay Preparation Stack	9.8
Pressing and Drying Stack	9.7
Dryer 1 Stack	10.7
Dryer 2 Stack	10.7
Glaze Line Stack	9.9
Selection Line Stack	9.9
Spray Dryer Stack	8.2
Kiln 1 Stack	10.9
Kiln 2 Stack	9.8
Hot Air Cooling Stack 1	9.4
Hot Air Cooling Stack 2	9.6

Table E4 Clay Prep Stack fine Particulate (PM10), Total Particulate Results 24 August 2011.

Sampling Conditions:				
Stack internal diameter at test location	995	mm		
Stack gas temperature (average)	24.8	^{o}C	298.0	K
Stack pressure (average)	1028	hPa		
Stack gas velocity (average, stack conditions)	14	m/s		
Stack gas flowrate (stack conditions)	11	m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	9.5	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	12:52	-	13:54	
Fine Particulate (PM_{10}) Mass	<0.1	mg		
Gas Volume Sampled	0.774	m^3		
Fine Particulate (PM_{10}) Emission*[1]	<0.13	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	<1.3	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	12:52	-	13:54	
Total Particulate Mass	1.1	mg		
Gas Volume Sampled	0.638	m^3		
Total Particulate Emission*[1]	1.7	mg/m^3		
Total Particulate Mass Emission Rate*[2]	16	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**5.3**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0^{o}C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E5 Dryer 1 Stack Fine particulate (PM_{10}) and Total Particulate Results, 22 September 2011.

Sampling Conditions:				
Stack internal diameter at test location	490	mm		
Stack gas temperature (average)	108.4	^{o}C	381.6	K
Stack pressure (average)	1022	hPa		
Stack gas velocity (average, stack conditions)	9.9	m/s		
Stack gas flowrate (stack conditions)	1.9	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	1.3	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	10:25	-	11:27	
Fine Particulate (PM_{10}) Mass	0.49	mg		
Gas Volume Sampled	0.661	m^3		
Fine Particulate (PM_{10}) Emission*[1]	0.74	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	0.95	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	10:25	-	11:27	
Total Particulate Mass	1.9	mg		
Gas Volume Sampled	0.78	m^3		
Total Particulate Emission*[1]	2.4	mg/m^3		
Total Particulate Mass Emission Rate*[2]	3.1	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**5.1**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E6 Dryer 2 Stack Fine Particulate (PM_{10}), Total Particulate Results 22 September 2011.

Sampling Conditions:				
Stack internal diameter at test location	490	mm		
Stack gas temperature (average)	112.2	^{o}C	385.4	K
Stack pressure (average)	1021	hPa		
Stack gas velocity (average, stack conditions)	10	m/s		
Stack gas flowrate (stack conditions)	2	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	1.3	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	12:56	-	13:58	
Fine Particulate (PM_{10}) Mass	<0.2	mg		
Gas Volume Sampled	0.656	m^3		
Fine Particulate (PM_{10}) Emission*[1]	<0.3	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	<0.39	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	12:56	-	13:58	
Total Particulate Mass	0.62	mg		
Gas Volume Sampled	0.753	m^3		
Total Particulate Emission*[1]	0.82	mg/m^3		
Total Particulate Mass Emission Rate*[2]	1.1	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**4.4**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E7 Glaze Line Stack Fine Particulate (PM_{10}), Total Particulate Results 24 August 2011.

Sampling Conditions:				
Stack internal diameter at test location	1000	mm		
Stack gas temperature (average)	26.0	^{o}C	299.2	K
Stack pressure (average)	1028	hPa		
Stack gas velocity (average, stack conditions)	14	m/s		
Stack gas flowrate (stack conditions)	11	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	10	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	11:21	-	12:48	
Fine Particulate (PM_{10}) Mass	<0.2	mg		
Gas Volume Sampled	1.02	m^3		
Fine Particulate (PM_{10}) Emission*[1]	<0.2	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	<2	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	11:21	-	12:48	
Total Particulate Mass	<0.2	mg		
Gas Volume Sampled	0.915	m^3		
Total Particulate Emission*[1]	<0.22	mg/m^3		
Total Particulate Mass Emission Rate*[2]	<2.2	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**1.2**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E8 Hot Air Cooler 1 Stack Fine Particulate (PM_{10}), Total Particulate Results 19 August 2011.

Sampling Conditions:				
Stack internal diameter at test location	1000	mm		
Stack gas temperature (average)	67.8	^{o}C	341.0	K
Stack pressure (average)	1006	hPa		
Stack gas velocity (average, stack conditions)	28	m/s		
Stack gas flowrate (stack conditions)	22	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	17	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	10:32	-	11:54	
Fine Particulate (PM_{10}) Mass	<0.2	mg		
Gas Volume Sampled	1.08	m^3		
Fine Particulate (PM_{10}) Emission*[1]	<0.19	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	<3.3	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	10:32	-	11:54	
Total Particulate Mass	4.1	mg		
Gas Volume Sampled	1.5	m^3		
Total Particulate Emission*[1]	2.7	mg/m^3		
Total Particulate Mass Emission Rate*[2]	46	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**1.6**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E9 Hot Air Cooler 2 stack Fine Particulate (PM_{10}), Total Particulate Results 19 August 2011

Sampling Conditions:				
Stack internal diameter at test location	1200	mm		
Stack gas temperature (average)	80.4	^{o}C	353.6	K
Stack pressure (average)	1009	hPa		
Stack gas velocity (average, stack conditions)	18	m/s		
Stack gas flowrate (stack conditions)	20	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	15	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	12:32	-	13:58	
Fine Particulate (PM_{10}) Mass	<0.2	mg		
Gas Volume Sampled	0.549	m^3		
Fine Particulate (PM_{10}) Emission*[1]	<0.36	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	<5	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	12:37	-	13:58	
Total Particulate Mass	<0.4	mg		
Gas Volume Sampled	0.483	m^3		
Total Particulate Emission*[1]	<0.83	mg/m^3		
Total Particulate Mass Emission Rate*[2]	<13	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**4.2**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E10 Pressing &Drying Stack, Fine Particulate (PM_{10}), Total Particulate Results 24 August 2011

Sampling Conditions:				
Stack internal diameter at test location	1000	mm		
Stack gas temperature (average)	25.8	^{o}C	299.0	K
Stack pressure (average)	1027	hPa		
Stack gas velocity (average, stack conditions)	14	m/s		
Stack gas flowrate (stack conditions)	11	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	9.8	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	13:11	-	14:32	
Fine Particulate (PM_{10}) Mass	1.44	mg		
Gas Volume Sampled	1.04	m^3		
Fine Particulate (PM_{10}) Emission*[1]	1.4	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	14	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	13:11	-	14:32	
Total Particulate Mass	7.18	mg		
Gas Volume Sampled	0.839	m^3		
Total Particulate Emission*[1]	8.6	mg/m^3		
Total Particulate Mass Emission Rate*[2]	84	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**1.4**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E11 Selection Line Stack, Fine Particulate (PM_{10}), Total Particulate Results 25 August 2011.

Sampling Conditions:				
Stack internal diameter at test location	490	mm		
Stack gas temperature (average)	27.8	^{o}C	301.0	K
Stack pressure (average)	1026	hPa		
Stack gas velocity (average, stack conditions)	5.9	m/s		
Stack gas flowrate (stack conditions)	1.1	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	1	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	10:28	-	11:30	
Fine Particulate (PM_{10}) Mass	<0.1	mg		
Gas Volume Sampled	0.767	m^3		
Fine Particulate (PM_{10}) Emission*[1]	<0.13	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	<0.19	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	10:28	-	11:30	
Total Particulate Mass	0.2	mg		
Gas Volume Sampled	1.03	m^3		
Total Particulate Emission*[1]	0.19	mg/m^3		
Total Particulate Mass Emission Rate*[2]	0.11	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**1.8**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E12 Spray Dryer Stack, Fine Particulate (PM_{10}), Total Particulate Results 22 August 2011.

Sampling Conditions:				
Stack internal diameter at test location	1385	mm		
Stack gas temperature (average)	101.3	^{o}C	374.5	K
Stack pressure (average)	1008	hPa		
Stack gas velocity (average, stack conditions)	22	m/s		
Stack gas flowrate (stack conditions)	34	m^3/s		
Stack gas flowrate ($0^{o}C$, dry gas, 1 atm pressure)	20	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	12:22	-	13:42	
Fine Particulate (PM_{10}) Mass	1.5	mg		
Gas Volume Sampled	1.08	m^3		
Fine Particulate (PM_{10}) Emission*[1]	1.4	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	28	mg/s		
Regulatory Limit	N/A			
Total Particulate Testing				
Test Period	12:22	-	13:42	
Total Particulate Mass	8.5	mg		
Gas Volume Sampled	1.07	m^3		
Total Particulate Emission*[1]	7.9	mg/m^3		
Total Particulate Mass Emission Rate*[2]	160	mg/s		
Regulatory Limit	20	mg/m^3		
Moisture Content (%)	**16.0**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**29**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of $0^{o}C$, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E13 Kiln 1 Stack, Fine Particulate (PM_{10}), Total Particulate, Particulate fluoride, Gaseous Fluoride Results 23 September 2011

Sampling Conditions:				
Stack internal diameter at test location	830	mm		
Stack gas temperature (average)	144.4	°C	417.6	K
Stack pressure (average)	1009	hPa		
Stack gas velocity (average, stack conditions)	14	m/s		
Stack gas flowrate (stack conditions)	7.6	m^3/s		
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	4.7	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	10:59	-	12:01	
Fine Particulate (PM_{10}) Mass	<0.1	mg		
Gas Volume Sampled	0.648	m^3		
Fine Particulate (PM_{10}) Emission*1 at 18% O_2	<0.12	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*2 at 18% O_2	<0.58	mg/s		
Regulatory Limit at 18% O_2	N/A			
Total Particulate Testing				
Test Period	10:59	-	12:01	
Total Particulate Mass	<0.1	mg		
Gas Volume Sampled	0.855	m^3		
Total Particulate Emission*1 at 18% O_2	<0.1	mg/m^3		
Total Particulate Mass Emission Rate*2 at 18% O_2	<0.48	mg/s		
Regulatory Limit at 18% O_2	20	mg/m^3		
Particulate Fluoride Testing				
Test Period	10:59	-	12:01	
Particulate Fluoride Mass	0.034	mg		
Gas Volume Sampled	0.923	m^3		
Particulate Fluoride Emission*1	0.037	mg/m^3		
Particulate Fluoride Mass Emission Rate*2	0.17	mg/s		
Regulatory Limit	5	mg/m^3		
Gaseous Fluoride Testing				
Test Period	10:59	-	12:01	
Gaseous Fluoride Mass	0.5	mg		
Gas Volume Sampled	0.923	m^3		
Gaseous Fluoride Emission*1	0.54	mg/m^3		
Gaseous Fluoride Mass Emission Rate*2	2.5	mg/s		
Regulatory Limit	5	mg/m^3		
Moisture Content (%)	**5.0**			
Gas Density (dry at 1 atmosphere)	**1.30**	**kg/m^3**		
Dry Molecular Weight	**29**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E14 Kiln 1 Sulfuric Acid Mist (H_2SO_4 as SO_3), Sulfur Dioxide (SO_2 as SO_3) Results, 16 August 2011.

Sampling Conditions:				
Stack internal diameter at test location	830	mm		
Stack gas temperature (average)	161.8	°C	435.0	K
Stack pressure (average)	1018	hPa		
Stack gas velocity (average, stack conditions)	17	m/s		
Stack gas flowrate (stack conditions)	9	m^3/s		
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	5.4	m^3/s		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Testing				
Test Period	11:44	-	13:49	
Sulfuric Acid Mist (H_2SO_4 as SO_3) Mass	3	mg		
Gas Volume Sampled	1.73	m^3		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Emission*1	1.7	mg/m^3		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Mass Emission Rate*2	9.2	mg/s		
Regulatory Limit	100	mg/m^3		
Sulfur Dioxide (SO_2 as SO_3) Testing				
Test Period	11:44	-	13:49	
Sulfur Dioxide (SO_2 as SO_3) Mass	140	mg		
Gas Volume Sampled	1.73	m^3		
Sulfur Dioxide (SO_2 as SO_3) Emission*1	81	mg/m^3		
Sulfur Dioxide (SO_2 as SO_3) Mass Emission Rate*2	440	mg/s		
Regulatory Limit	NA			
Moisture Content (%)	**5.0**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**29**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E15 Kiln 1 Stack Hazardous Substances (Metals), Results 16 August 2011.

Sampling Conditions:				
Stack internal diameter at test location	830	mm		
Stack gas temperature (average)	161.8	^{o}C	435.0	K
Stack pressure (average)	1018	hPa		
Stack gas velocity (average, stack conditions)	17	m/s		
Stack gas flowrate (stack conditions)	9	m^3/s		
Stack gas flowrate (0^{o}C, dry gas, 1 atm pressure)	5.5	m^3/s		
Hazardous Substances (Metals) Testing				
Test Period	11:44	-	13:49	
Hazardous Substances (Metals) Mass	0.16	mg		
Gas Volume Sampled	1.33	m^3		
Hazardous Substances (Metals) Emission*[1]	0.12	mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*[2]	0.66	mg/s		
Regulatory Limit	1	mg/m^3		
Moisture Content (%)	**3.8**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**29**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0^{o}C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E16 Kiln 2 Stack Fine Particulate (PM_{10}), Total Particulate, Particulate Fluoride, Gaseous Fluoride Results, 23 September 2011.

Sampling Conditions:				
Stack internal diameter at test location	830	mm		
Stack gas temperature (average)	102.0	°C	375.2	K
Stack pressure (average)	1010	hPa		
Stack gas velocity (average, stack conditions)	6.9	m/s		
Stack gas flowrate (stack conditions)	3.7	m^3/s		
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	2.5	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	14:33	-	15:34	
Fine Particulate (PM_{10}) Mass	0.1	mg		
Gas Volume Sampled	0.69	m^3		
Fine Particulate (PM_{10}) Emission*1 at 18% O_2	0.024	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*2 at 18% O_2	0.06	mg/s		
Regulatory Limit at 18% O_2	N/A			
Total Particulate Testing				
Test Period	14:33	-	15:34	
Total Particulate Mass	0.2	mg		
Gas Volume Sampled	0.783	m^3		
Total Particulate Emission*1 at 18% O_2	0.044	mg/m^3		
Total Particulate Mass Emission Rate*2 at 18% O_2	0.11	mg/s		
Regulatory Limit at 18% O_2	20	mg/m^3		
Particulate Fluoride Testing				
Test Period	14:33	-	15:34	
Particulate Fluoride Mass	0.012	mg		
Gas Volume Sampled	1.14	m^3		
Particulate Fluoride Emission*1	0.011	mg/m^3		
Particulate Fluoride Mass Emission Rate*2	0.028	mg/s		
Regulatory Limit	5	mg/m^3		
Gaseous Fluoride Testing				
Test Period	14:33	-	15:34	
Gaseous Fluoride Mass	0.2	mg		
Gas Volume Sampled	1.14	m^3		
Gaseous Fluoride Emission*1	0.18	mg/m^3		
Gaseous Fluoride Mass Emission Rate*2	0.45	mg/s		
Regulatory Limit	5	mg/m^3		
Moisture Content (%)	**6.8**			
Gas Density (dry at 1 atmosphere)	**1.33**	**kg/m^3**		
Dry Molecular Weight	**29.7**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E17 Kiln 2 Hazardous Substances (Metals), Sulfuric Acid Mist (H_2SO_4 asSO_3), Sulfur Dioxide (SO_2 as SO_3) Results, 16 August 2011

Sampling Conditions:				
Stack internal diameter at test location	830	mm		
Stack gas temperature (average)	120.6	^oC	393.8	K
Stack pressure (average)	1009	hPa		
Stack gas velocity (average, stack conditions)	15	m/s		
Stack gas flowrate (stack conditions)	8	m^3/s		
Stack gas flowrate (0^oC, dry gas, 1 atm pressure)	5	m^3/s		
Hazardous Substances (Metals) Testing				
Test Period	10:42	-	12:06	
Hazardous Substances (Metals) Mass	0.12	mg		
Gas Volume Sampled	1.19	m^3		
Hazardous Substances (Metals) Emission*1	0.1	mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.51	mg/s		
Regulatory Limit	1	mg/m^3		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Testing				
Test Period	10:42	-	12:06	
Sulfuric Acid Mist (H_2SO_4 as SO_3) Mass	5	mg		
Gas Volume Sampled	0.751	m^3		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Emission*1	6.7	mg/m^3		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Mass Emission Rate*2	33	mg/s		
Regulatory Limit	100	mg/m^3		
Sulfur Dioxide (SO_2 as SO_3) Testing				
Test Period	10:42	-	12:06	
Sulfur Dioxide (SO_2 as SO_3) Mass	70	mg		
Gas Volume Sampled	0.751	m^3		
Sulfur Dioxide (SO_2 as SO_3) Emission*1	93	mg/m^3		
Sulfur Dioxide (SO_2 as SO_3) Mass Emission Rate*2	460	mg/s		
Regulatory Limit	NA			
Moisture Content (%)	**6.5**			
Gas Density (dry at 1 atmosphere)	**1.30**	**kg/m^3**		
Dry Molecular Weight	**29.4**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0^oC, 1 atm, dry gas
*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table E18 Kiln 1 stack Hazardous Substances Elemental Analysis Results, 16 August 2011.

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m^3)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m^3)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m^3)	Total (mg)	Total (mg/m^3)	Mass Emission Rate (mg/s)
Antimony	<0.004	<0.003	<0.004	<0.003			<0.02	<0.003	<0.016
Arsenic	0.018	0.014	0.015	0.011			0.03	0.025	0.14
Beryllium	<0.00004	<0.00003	<0.00003	<0.000023			<0.00012	<0.00003	<0.00016
Cadmium	0.0052	0.0039	0.00039	0.00029			0.006	0.0042	0.023
Chromium	<0.0064	<0.0048	0.0012	0.00091			0.0012	0.00091	0.005
Cobalt	<0.0033	<0.0025	<0.0003	<0.00023			<0.0015	<0.0025	<0.014
Copper	0.002	0.0015	0.00095	0.00072			0.003	0.0022	0.012
Lead	0.0061	0.0046	<0.003	<0.0023			0.0061	0.0046	0.025
Magnesium	NA	NA	NA	NA			NA	NA	NA
Manganese	0.019	0.014	0.037	0.028			0.06	0.042	0.23
Mercury	0.00036	0.00027	0.0026	0.002	0.0061	0.0046	0.009	0.0069	0.038
Nickel	0.0013	0.00098	0.00028	0.00021			0.002	0.0012	0.0066
Selenium	0.0046	0.0035	<0.004	<0.003			0.0046	0.0035	0.019
Thallium	<0.008	<0.006	<0.008	<0.006			<0.04	<0.006	<0.033
Tin	0.015	0.011	0.024	0.018			0.04	0.029	0.16
Vanadium	<0.0004	<0.0003	<0.0004	<0.0003			<0.02	<0.0003	<0.0016
Zinc	NA	NA	NA	NA			NA	NA	NA
Total Hazardous Metals*	**0.072**	**0.054**	**0.081**	**0.061**	**0.0061**	**0.0046**	**0.16**	**0.12**	**0.67**
Total Metals	**0.072**	**0.054**	**0.081**	**0.061**			**0.16**	**0.12**	**0.67**

* Total does not include Magnesium and Zinc as they are classed non-hazardous

Table E19 Kiln 2 Hazardous Substances Elemental Analysis Results 16 August 2011

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m^3)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m^3)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m^3)	Total (mg)	Total (mg/m^3)	Mass Emission Rate (mg/s)
Antimony	0.0038	0.0032	<0.004	<0.0034			0.0038	0.0032	0.016
Arsenic	0.013	0.011	0.025	0.021			0.04	0.032	0.16
Beryllium	0.00002	0.000017	<0.00003	<0.000025			0.00002	0.000017	0.000087
Cadmium	0.0013	0.0011	0.00019	0.00016			0.001	0.0013	0.0067
Chromium	0.0046	0.0039	0.0016	0.0013			0.006	0.0052	0.027
Cobalt	0.0005	0.00042	<0.0003	<0.00025			0.0005	0.00042	0.0022
Copper	0.002	0.0017	0.0019	0.0016			0.004	0.0033	0.017
Lead	<0.003	<0.0025	<0.003	<0.0025			<0.015	<0.0025	<0.013
Magnesium	NA	NA	NA	NA			NA	NA	NA
Manganese	0.026	0.022	0.018	0.015			0.04	0.037	0.19
Mercury	0.00011	0.000093	0.0025	0.0021	0.0048	0.004	0.007	0.0062	0.032
Nickel	<0.0011	<0.00093	0.0026	0.0022			0.0026	0.0022	0.011
Selenium	0.0057	0.0048	<0.004	<0.0034			0.0057	0.0048	0.025
Thallium	<0.008	<0.0067	<0.008	<0.0067			<0.04	<0.0067	<0.034
Tin	0.004	0.0034	0.0015	0.0013			0.006	0.0047	0.024
Vanadium	0.00032	0.00027	<0.0004	<0.00034			0.00032	0.00027	0.0014
Zinc	NA	NA	NA	NA			NA	NA	NA
Total Hazardous Metals*	**0.061**	**0.052**	**0.053**	**0.045**	**0.0048**	**0.004**	**0.12**	**0.098**	**0.51**
Total Metals	**0.061**	**0.052**	**0.053**	**0.045**			**0.12**	**0.098**	**0.51**

* Total does not include Magnesium and Zinc as they are classed non-hazardous

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Appendix F

Noise Assessment Results

Appendix F Noise Assessment Results

Project No: 08397/4405

Noise Compliance Study
National Ceramic Industries Australia
Rutherford, NSW

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June 2012

CONTENTS

INTRODUCTION

This report provides the results and findings of a compliance noise monitoring programme undertaken in June 2012 at National Ceramic Industries Australia (NCIA) in Racecourse Road, Rutherford, NSW.

The assessment has been carried out in accordance with the requirements of NCIA's Environmental Protection Licence (EPL) no. 11956. The methodology used in this programme is aimed to most effectively determine compliance with the noise limits in the EPL.

NOISE LIMITS

The noise limits applicable to NCIA's operations are detailed below:

Noise from the premises must not exceed:

(a) 41 dB(A) Leq (15 min) during the day (7 am to 6 pm) Monday to Saturday and (8 am to 6 pm) Sunday and public holidays;

(b) 39 dB(A) Leq (15 min) during the evening (6 pm to 10 pm) Monday to Sunday and public holidays; and

(c) At all other times 35 dB(A) Leq (15 min), except as expressly provided by this licence.

Noise from the premises is to be measured at the most affected point on or within the receptor site boundary to determine compliance with this condition.

Noise from the premises shall not exceed the L1 (1 min) noise level of 45 dB(A) at the nearest residential receiver most affected by noise from activities at the premises. This noise limit applies 1 metre from the dwelling facade and shall apply during the night time period only.

These noise conditions apply under all meteorological conditions except during rain, wind speeds greater than 3m/s (at 10m above ground level) and intense temperature inversions (greater than +3°/100m) between 6 pm and 7 am.

METHODOLOGY

The NCIA facility is located within the Rutherford industrial estate. The closest and most potentially impacted residential receivers to the site are in Kenvil Close, Rutherford, approximately 1 km from the site. The

NCIA site is separated from the nearest residential receivers by vacant land previously occupied by the Westside Golf Course. Other residential receivers are located in a rural/residential area along Wollombi Road, Farley to the south of the NCIA site.

A series of attended noise measurements, of 15 minutes duration, were made in Kenvil Close and in Wollombi Road on Monday 18 June 2012 during the day, evening and night time periods. During, the day time period, measurements were also made on the NCIA site.

At the time of the monitoring activities at NCIA were being carried out under typical operating conditions.

Noise emission levels were measured with a Brüel & Kjær Type 2250 Precision Sound Analyser. This instrument has Type 1 characteristics as defined in AS1259-1982 "Sound Level Meters". Calibration of the instrument was confirmed with a Brüel & Kjær Type 4231 Sound Level Calibrator Prior to and at the completion of measurements.

During all of the monitoring periods conditions were cool to mild with very little cloud cover. Wind speeds measured at approximately 2m above ground level indicated light winds at between 0.5 and 1.5m/s from the north to north west.

No information was available in relation to temperature inversions at night.

RESULTS

The results of the attended noise measurements at each location and time are shown below in **Table 1**. To avoid undue disturbance to residents, all measurements in Kenvil Close were made in the reserve at the western end of the street. This location is approximately in line with the nearest façade of the most potentially affected receivers in Kenvil Close.

In Wollombi Road the measurements were made in a clearing adjacent to the most potentially affected receiver. The location had line of sight to the NCIA facility.

The measurement locations are shown in **Appendix 1**.

Measured noise levels for each time are summarised in the table. The total measured Leq is shown. This was analysed with the Bruel & Kjaer "*Evaluator*" software to quantify the contributions of the various noise source(s) to the overall. The noise measurements were made over of one second statistical intervals with each one second interval

accompanied by a one third octave band noise spectrum. Viewing the 15 minute time trace with the accompanying field notes for the monitoring period allows for individual noise sources and events to be isolated. The "evaluator" software can be used to add together the noise levels and durations of each identified noise source. The relative contribution(s) of each to the overall can then be determined.

The noise sources are listed in the comments column with the contribution of each shown in brackets.

TABLE 1
RECEIVED NOISE LEVELS – 18 JUNE 2012

Location	Time	dB(A),Leq (15 min)	Wind speed/ direction	Identified Noise Sources	Criterion dB(A) Leq (15 min)
Kenvil Close	1:10 pm	47	1.5/NW	Other industry (46), traffic (38) birds (33), NCIA not measureable	41
Kenvil Close	9:00 pm	51	1/NW	Other industry (46), frogs (41), distant traffic (30), NCIA not measureable	39
Kenvil Close	10:50 pm	47	0.5/N	Other industry (45), frogs (42), NCIA not measurable	35
Wollombi Road	1.30 pm	64	1.5/NW	Local traffic (64), other industry (40), trains (38), NCIA not measureable	41
Wollombi Road	9.25 pm	65	2.0/NW	Local traffic (65), other industry (41), traffic (41), NCIA not measureable	39
Wollombi Road	10.30 pm	37	0.5/N	Other industry (37), NCIA not measureable	35

The results in Table 1 show that the received noise from the NCIA site was not directly measureable during the monitoring survey. The measurements made at the NCIA site showed that noise emissions from NCIA are relatively steady state with little variation over time.

Throughout entire survey the acoustic environment of the residential areas around Kenvil Close and Wollombi Road was dominated by noise from an industry in close proximity to the NCIA site. This was particularly evident during the evening and night.

During the day there was also significant contribution from noise from other industries in the Rutherford Industrial Estate and from traffic on the New England Highway.

Observations in the industrial estate indicated that several of the industries were also operating during the evening and night. At these times, noise emissions from these industries tended to be at variable levels and were only a minor contributor to the overall measured Leq noise levels.

Noise from traffic on Wollombi Road is relatively acoustically continuous throughout the day and evening. During the night the traffic flow becomes more sporadic and the noise from individual vehicles can be isolated from the measurements prior to further analysis.

As discussed above, the site noise measurements showed that noise emissions from NCIA are relatively steady state. The measurements were made at various locations in the grassed buffer area to the east of the plant.

There was, similarly, little variation in noise level along the length of the building. The loudest consistent noise emissions from the site were from the area of the bag house and exhaust stacks near the central parts of the building.

From the representative site measurements of day time noise emissions a sound power level for the overall building was able to be determined as shown below in **Table 2**.

Table 2 also shows a theoretical calculation of the noise level propagated to receivers in Kenvil Close (approximately 1km away). Note the calculation assumes neutral atmospheric conditions and 50% relative humidity.

TABLE 2
CALCULATED SPL AT KENVIL CLOSE – NCIA (Leq (15 min))

		Octave Band Centre Frequency, Hz							
Item	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	103	91	97	97	95	93	93	86	80
Distance Loss (1000 m)		68	68	68	68	68	68	68	68
Atmospheric absorption		0	1	1	3	5	10	20	40
SPL @ receiver	32.5	23	28	28	24	20	15	<0	<0
Criterion (night)	35								

The results in Table 2 show that the calculated theoretical received noise, in Kenvil Close, from NCIA was below the most stringent night time noise criterion under the assessed neutral atmospheric conditions. As all other residences are further removed from the site the received noise levels at these will also be in compliance with the criteria.

There were no discernable L1 (1 min) events from NCIA during any of the measurements. The only L1 (1 min) industrial noise came from another industrial site not related to NCIA.

L1 (1 min) noise levels measured on the NCIA site (during the day) did not vary by more than 2 - 3 dB(A) from the measured Leq noise levels.

Based on the results in Table 2 this means that the L1 (1 min) noise at the closest receivers to the site in Kenvil Close would be significantly lower than the 45 dB(A) criterion for the site.

CONCLUSIONS

The noise assessment of emissions from NCIA has been undertaken by measuring noise levels at the most potentially affected residential area in Kenvil Close, Rutherford and Wollombi Road, Farley to determine compliance with requirements of EPL 11956.

The measurements were inconclusive as the acoustic environment of both sites was dominated by emissions from other industries not related to NCIA.

Theoretical calculations were carried out to predict received noise levels under neutral atmospheric conditions. The predicted noise levels were in compliance with the noise criteria for all time periods.

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SITE PLAN AND MONITORING LOCATIONS