BALLINA SHIRE COUNCIL

SEPARATE ATTACHMENT
(Attachment 6)

Item 8.2 – DA 2017/679 – 77 Teven Road, Alstonville

Ordinary Meeting 22/3/18

tim fitzroy & associates
environmental health environmental education environmental auditing

8 February 2018
Ref: 84/2017

The General Manger
Ballina Shire Council
PO Box 450
BALLINA NSW 2478

Attention: Jessica Hutley

Dear Jessica

RE: Addendum to Land Use Conflict Risk Assessment Extractive Industry (Quarry), Asphalt/Bitupave and Ron Southon Depot & Proposed Residential Subdivision Lot 83 DP 239781 No 77 Teven Road Alstonville

This letter is submitted as an Addendum to a *Land Use Conflict Risk Assessment Extractive Industry (Quarry), Asphalt/Bitupave and Ron Southon Depot & Proposed Residential Subdivision Lot 83 DP 239781 No 77 Teven Road Alstonville* (Tim Fitzroy & Associates 24 November 2017). This correspondence has been prepared in response to items 3 and 4 Council's Request for Further Information (RFI) and matters raised in a subsequent meeting on 12 January 2018 between Jessica Hutley and Stewart Lloyd (Ballina Shire Council), Paul Snellgrove (Ardill Payne and Partners) and Tim Fitzroy (Tim Fitzroy & Associates).

Relevant matters raised in the RFI are listed below:

4. Provide validation through a noise impact assessment to validate the impact and provide specific noise levels upon future residents. It is recommended that your noise consultant discuss with Council the further noise assessment methodology, prior to conducting any further assessment.

5. Provide an air quality impact statement to validate any future potential impacts on the allotments.

Following discussion at the aforementioned meeting it was agreed to prepare an Addendum to the LUCRA inclusive of:

1. Noise
    a. A review Garry Hall's NIA for adjoining dwelling.
    b. Remodel where necessary noise impacts on proposed development.
    c. Advise method of construction for proposed development where possible.

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2. Air Quality
    a. Provide copies of Odour Impact Assessment to Council.
    b. Include results of complaints (expand on existing).
    c. Refer to Licence 959 Bitupave, now non licensed by under EPA is the ARA.
    d. Include information from EPA help line on what this means.
    e. Provide examples of previous licence.

1 Noise Impacts

At the request of Council TFA has conducted a review of the *Noise Impact Assessment Operations of Boral Asphalt and Tuckombil Quarry at 486 Gap Road Alstonville on Proposed Residence at Lot 2 DP 800081 Gap Rd Alstonville* (Ambiance Audio, 16 July 2014) (see **Attachment A**).

The proposed residence was to be located in the south west portion of Lot 2 DP 800081 and approximately 120m north of the closest point of the subject lot (77 Teven Road, Alstonville).

According to Ambiance Audio (2014) the distance from the closest façade (north east) to the quarry related activities is as follows:

Table 1 Distance from the closest façade (north east) of Proposed Dwelling at Lot 2 DP 800081 to the quarry related activities

Asphalt Stockpiles	450m
Asphalt Plant	470m
Current Quarry Operations	600+m
Quarry Stockpiles	275m
Quarry Boundary	210m

Based on the proposed residential subdivision plan for 77 Teven Road, the closest points to the quarry of proposed lots 1 to 5 (actual dwelling locations are as yet unknown) are described in **Table 2**.

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Table2 Distance from the closest façade (north east) of closest Dwelling in proposed residential subdivision plan at 77 Teven Road to the quarry related activities

Activity	Lot 1	Lot 2	Lot 3	Lot 4
Asphalt Stockpiles	400m	500m	500m	530m
Asphalt Plant	412m	426m	440m	467m
Current Quarry Operations	600 +m	600 +m	600 +m	600 +m
Quarry Stockpiles	330m	330m	356m	353m
Quarry Boundary	250m	254m	280m	274m

Note: The remaining lots (6 to 10 inclusive) in the proposed subdivision are shielded by adjoining dwellings to the north and future dwellings will be sufficiently setback from the quarry and asphalt plant as to not require noise attenuation

EPA Licence Noise Criteria

The Tuckombil Quarry whilst not currently operating (postponed in 2016) still retains an Environmental Protection Licence (EPL) issued by the NSW Environment Protection Authority (EPA). EPL: 3856 for Tuckombil Quarry states that:

L4 Noise limits

L4.1 Noise from the licensed premise must not exceed an LAeq (15 minute) noise emission criterion of 38, except as expressly provided by this licence.

L4.2 Noise from the premises is to be measured at the most affected residential receiver to determine compliance with this condition.

The Boral Asphalt Plant was previously licenced with the NSW EPA for Bitumen pre-mix or hot-mix production. On 28 April 2000 the NSW EPA removed the requirement for the Asphalt Plant to be licenced under the POEO Act. The Environment Protection Authority (EPA) is still the Appropriate Regulatory Authority (ARA) however the premises are no longer required to be licensed under the Protection of the Environment Operations Act 1997 (POEO Act). The pre existing noise limits are provided below:

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L6.1 Noise from the premises must not exceed the limits as set out in Table 1

Table 1.

Location	Evening $L_{Aeq(15min)}$	Night $L_{Aeq(15min)}$
214 Teven Road*	N/A negotiated agreement in place	
29 Granada Parade	38 dB(A)	35 dB(A)
81 Teven Road	38 dB(A)	35 dB(A)

* Note: Negotiated agreement in place between the owner and occupier of 214 Teven Road and the licensee.

It would be expected that the evening limit of 38 Laeq (15min) and the night time limit of 35 Laeq (15min) would apply to residential dwellings in the proposed subdivision.

81 Teven Road is located:

- 100m south east of the proposed dwelling site on Lot 2 DP 800081;
- 460m south west of the asphalt plant; and
- 20m north of the nearest northern façade of dwellings in the proposed residential subdivision at 77 Teven Road.

Noise Monitoring

Ambiance Audio (2014) concluded as follows:

Results of noise monitoring of the asphalt plant and quarry at the proposed building site indicate a level of 35 dBA $L_{Aeq,15min}$ for each of the asphalt plant and quarry operations under load conditions for the day time period. It is predicted the combined day time noise level is 38 dBA $L_{Aeq,15min}$ which complies with the PSNG. The noise level of the asphalt plant at the proposed building site is 35 dBA $L_{Aeq,15min}$ which complies with the evening and day time PSNG.

Noise levels from the asphalt plant and quarry may increase at the proposed building site due to changes of operations at the asphalt plant and quarry. These increases will also equally affect the existing residential dwellings 25 – 30 metres to the west of the proposed building site. Similarly, any increase in noise levels at the proposed building site due to meteorological conditions will also have an equal increase at the nearby existing residential dwellings.

Additional quarry related traffic on Teven Road is not considered to have any significant noise impact on the proposed residential dwelling.

Blast over-pressure and ground vibration levels are predicted to be below the allowed limits at the proposed residential dwelling.

Noise levels from the nearby Tuckombil quarry and asphalt operations at the proposed residential dwelling will comply the NSW Industrial Policy.

TFA Comment

Based on the proposed subdivision plan (Ardill Payne & Partners, Drawing SK1, 10 November 2017) the closest façade of a future dwelling will be approximately 120m south of the dwelling at Lot 2 DP 800081.

The Ambiance Audio report is based on noise assessment undertaken at the site of

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the proposed dwelling not at the source of the asphalt plant nor the quarry. Ambiance Audio (2014) includes measurements of both Asphalt plant and Quarrying operations at the proposed dwelling site that were co-ordinated with the asphalt plant and quarry operators and Garry Hall (acoustic engineer) to identify noise sources at the receptor (see extract below)

The 2250 SLM was mounted on a 1.4m high tripod and a Bruel and Kjær outdoor microphone kit fitted to the microphone. The SLM was located at the proposed SW corner building site on the lot to record asphalt plant operations while operating under load conditions. The asphalt plant would not allow a sound level meter to be located on site to record reference noise levels while the plant was under operating conditions. Phone calls were used to coordinate between the plant supervisor to inform of the operating conditions at the asphalt plant.

The measurements were recorded over 15 minute periods with 1 second logging. Markers and sound recordings were used during the noise monitoring to identify the noise level and duration of acoustic events for later analysis.

Given that measurements were not taken at the noise source it is not possible to directly predict the impacts at the proposed subdivision from Ambiance Audio (2014). It is important to note that Ambiance Audio (2014) includes noise impacts from both asphalt and quarrying activities.

Ambiance Audio (2014) does however provide contextual data on noise impacts from asphalt and quarrying activities and coupled with the Compliance Noise Monitoring ((Hyder Consulting Australia (October 2004), Heggies Australia 25 October 2005 and NMA Muller Acoustic Consulting Pty Ltd (MAC) September 2017)) for Alstonville Asphalt Plant, that enables some inferences to be made as to the noise impacts from asphalt and quarrying activities on the proposed subdivision. In addition Muller (2017) (see **Attachment B**) suggests the asphalt plant contributes up to 6dB above the Project Specific Noise Level (PSNL) for R1 during the evening and night period due to tonal effects. R2 appears to be the closest receptor to the proposed subdivision and it is predicted to be within the PSNL. R1 is predicted to exceed the PSNL by 6dBA (including tonality penalty) but it is located to the south, therefore it is assumed that the southern direction from the Asphalt plant is the worst affected.

Ambiance Audio (2014) established

The internal noise levels from the asphalt plant during the evening and night time periods will meet the requirements of AS/NZS 2107:2000 - Sleeping Areas - Satisfactory 30dB (A), Maximum 35 dB(A) and Living Areas – Satisfactory 30 dB(A), Maximum 40 dB(A) for houses and apartments near minor roads. All values L_{Aeq}. Windows tend to be kept closed during winter months which will reduce internal noise further.

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1. Predicted Leq 15min noise levels identified activities such as trucks maneuvering/ passbys and reversing as exceeding the background level in the Day, Evening and Night time periods.
2. The potential noise impacts from vehicle air brakes arriving and leaving the site have not been considered for the morning, evening and night periods.
3. Any activities that have the potential to cause sleep disturbance have not been assessed.
4. The noise mitigation measures outlined in section 5 of the report are considered inadequate to effectively control and manage noise emissions to an acceptable level.

TFA Comment

Based on the data at hand it appears that the land use conflict risk with respect to noise generating activities between the existing asphalt plant and quarrying operations (should they recommence in the future) and future dwellings in the proposed subdivision to be low.

Nevertheless adopting the precautionary principle it is recommended that future dwellings in Lots 1 to 5 (inclusive) be constructed of standard construction with acoustic seals to windows facing the quarry/asphalt plant and the provision of air conditioning in habitable rooms to allow residents with the opportunity to be close windows to maintain internal acoustic amenity when required.

Road Traffic Noise

EMM Consulting Pty Limited (EMM) was engaged by Boral National to conduct a road traffic noise assessment relevant to the asphalt plant located at 498 Gap Road, Alstonville to satisfy Condition 25 of DA 1995/127 (Amendment No. 4). Condition 25 of Amendment No. 4 (Approved on 10 August 2016) states;

Prior to the sourcing of aggregates and fines from proposed sources other than the adjoining Gap Road Quarry, a traffic noise assessment report prepared in accordance with the requirements of appendix B of the NSW Road Noise Policy must be submitted to and approved by council.

All relevant data and information utilised in this assessment has been referenced from the document *Traffic assessment – Modification to development consent (EMM 2016) (see* **Attachment C***)* .EMM has completed a road traffic noise assessment to satisfy Condition 25 of DA 1995/127 (Amendment No. 4). Road traffic noise levels were assessed against the relevant assessment criteria from the RNP (EPA 2011) relevant to residential land uses.

TFA Comment

ENM found that predicted operational road traffic noise levels satisfy the relevant RNP noise requirements at all nearest assessment locations on the transport route.

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2 Air Quality

a. Odour Impact Assessment (OIA)

At council's request please find attached a copy of the Odour Impact Assessment (Air Environment Consulting 2017) (**Attachment D**) commissioned by Boral National (Boral) for the Boral Alstonville Asphalt Plant.

b. Air (Dust Monitoring)

The Environmental Management Plan for the Tuckombil Quarry states that dust monitoring will be conducted on a three monthly basis. Discussion with the previous owner of Australian Soil and Concrete Testing (ASCT) Mr Brian Dick has confirmed that ASCT were engaged by Lismore City Council to undertake dust monitoring at Tuckombil Quarry. An Environmental Audit of the Tuckombil Quarry was conducted by Newton Denny Chappelle (2007-2013). The author of the Environmental Audit Karina Vikstrom (pers. com 24 January 2018) confirmed that she viewed certain records online via the Council trim service.

Despite inquiries by the applicant to Ballina Shire Council copies of the dust monitoring results have not been recovered.

The audit states that between 2007 – 2013 there were two dust complaints in 2010. In response, increased water cart usage was undertaken and no further complaints were received.

It is noted the EPL 3856 for the Tucombil Quarry does not require dust or air monitoring.

c. Additional Air Quality Complaints

A summary of EPA Complaints and Noise from January to June 2017 for the Alstonville Asphalt Plant are provided in **Attachment E**. The Tuckombil Quarry has not been in operation since 2016. The future of the Tuckombil Quarry is being currently considered by Council.

Non compliances with respect to EPL 3856 for the Tuckombil Quarry are provided in **Attachment E** and relate to water quality discharge.

d. Bitupave EPL 959

The Boral Asphalt Plant was previously licenced with the NSW EPA for Bitumen pre-mix or hot-mix production. On 28 April 2000 the NSW EPA removed the requirement for the Asphalt Plant to be licenced under the POEO Act. The Environment Protection Authority (EPA) is still the Appropriate Regulatory Authority (ARA) however the premises are no longer required to be licensed under the Protection of the Environment Operations Act 1997 (POEO Act).

The most recent notice of variation (24 July 2008) is provide in **Attachment F.** Key modifications to EPL 959 are provided below:

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The most recent notice of variation (24 July 2008) is provided in **Attachment F**.

L6.1 Noise from the premises must not exceed the limits as set out in Table 1.

Table 1

Location	Evening LA10(15min)	Night LA10(15min)
214 Tavan Road	N/A negotiated agreement in place	
29 Granada Parade	36 dB(A)	35 dB(A)
91 Tavan Road	36 dB(A)	35 dB(A)

Note: Negotiated agreement in place between the owner and occupier of 214 Tavan Road and the licensee.

For the purpose of condition L6.1

(a) Evening is defined as the period from 6pm to 10pm.

(b) Night is defined as the period from 10pm to 7am Monday to Saturday, and 10pm to 8am Sundays and Public Holidays.

L6.2 Where the noise emission limits identified in this licence have been exceeded the source should be established and Lbypass undertaken.

L6.3 To determine compliance with condition L6.1 noise must be measured at, or corrected for the affected residences detailed in Table 1. Noise from the premises is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the affected dwelling (rural situations) where the dwelling is more than 30 metres from the boundary.

Where it can be demonstrated that direct measurement of noise from the premises is impractical, the licensee may use alternative means of demonstrating compliance to the EPA. (see Chapter 11 of the NSW Industrial Noise Policy).

A modifying factor correction must be applied for tonal, impulsive or intermittent noise in accordance with the "Environmental Noise Management - NSW Industrial Noise Policy (January 2000)".

L6.4 The noise emission limits identified in condition L6.1 apply under calm meteorological conditions.

L7 Hours of Operation

L7.1 All work at the premises must normally be conducted between the hours 6:00am to 5:30pm Monday to Saturday inclusive.

L7.2 24 hour operations for up to 60 days per annum may be carried out at the premises. 24 hour operations are not to be undertaken for more than 4 consecutive days at any time.

L7.3 Sunday work and work on public holidays is only to be undertaken where specific approval from the EPA has been received by the company for each event. Sunday or public holiday work must be limited to a case for repair or emergency work.

L7.4 Records are to be kept for all operations conducted on Sundays, public holidays and for evening or night operations conducted between 5:00pm and 7:00am. These records are to include the times of start up and shut down of the plant. All such records are to be available to the EPA on request.

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It should be noted that the EPA so does not require air quality or noise monitoring of the asphalt plant.

e. Copies of previous EPL Licences

Copies of previous EPL's for the Asphalt Plant and Tuckombil Quarry are provided in **Attachment G**.

If you have any enquiries with regard to the content of this correspondence do not hesitate to contact me on ph 02 66 28 3837 or email tim@timfitzroy.com.au.

Kind regards,

Tim Fitzroy
Environmental Health Scientist
Environmental Auditor

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Attachment A **Noise Impact Assessment (Ambiance Audio 2014)**

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Appendix 2

Noise Impact Assessment

Ambience Audio Services

Acoustical Measurement and Analysis

15 Tamarind Close
Richmond Hill NSW 2480

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Noise Impact Assessment of Operations of Boral Asphalt Plant and Tuckombil Quarry at 486 Gap Road Alstonville

on a Proposed New Residence at Lot 2 DP 800081 Greenie Drive Alstonville NSW 2477

for

Mr Errol Beaumont
27 Pine Avenue
Mullumbimby NSW 2482

Prepared by
Garry Hall
16th July 2014

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1 INTRODUCTION

A noise impact assessment of quarry and asphalt plant operations from nearby quarry operations was requested by Mr Stephen Fletcher, Environmental Planning Consultant with Stephen Fletcher & Associates, for a proposed new dwelling to be constructed in the south-west corner of Lot 2 DP 800081 Greenie Drive Alstonville. The request is in response to correspondence from Ballina Shire Council, that due to the proposed dwelling being within the 1000m minimum buffer zone for extractive industries and blasting, a noise and vibration impact assessment will be required.

This report assesses the proposed new residential dwelling with the criteria in the New South Wales Government Industrial Noise Policy, the NSW EPA Environment Protection Licenses issued to operators of the nearby asphalt plant and quarry and Australian/New Zealand Standard – AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors.* This report references information from a previous noise impact assessment (15/07/13) and addendum report (18/11/13) prepared by Ambience Audio Services for a proposed residential dwelling to be located in the north-west corner of the same lot.

To assist with the interpretation of some of the terminology used in this report, Appendix A provides definitions of acoustic terms. Appendix B is a chart of the comparison of everyday sound pressure levels. A location map is included in Appendix C.

2 SITE DESCRIPTION

The proposed building site is Lot 2 DP 800081 Greenie Drive, Alstonville NSW 2478. The subject property has an area of 5.624 hectares, slopes gently to the north east, has only a few trees and is mainly used for cattle grazing.

The surrounding area is rural (mainly cattle and fruit trees), rural residential, residential and a basalt quarry. The lot is bounded by Greenie Drive and residential / rural residential opposite to the north, residential to the north west, west and south, Teven Road and rural opposite to the south east and Teven Road and Boral Asphalt Plant and Tuckombil Quarry opposite to the East. The proposed building site for the proposed single storey dwelling is in the south west corner of the lot with access from Greenie Drive (*see location map – Appendix C and building plans – Appendix D.*

The distance from the closest façade (north eastern façade) to quarry related operations is presented in Table 2.1 below.

Table 2.1 Approximate Distance from Closest Proposed Dwelling Façade	
Asphalt Stockpiles	450m
Asphalt Plant	470m
Current Quarry Operations	600+m
Quarry Stockpiles	275m
Quarry Boundary	210m

Operations conducted at the quarry are production of asphalt, removing overburden, blasting, crushing, stockpiling and transportation of finished product for roadwork and airport construction.

Bitupave hold a NSW EPA licence for the asphalt plant which is currently operated by Boral Asphalt. Operating hours are 6am – 6pm Monday to Saturday (excluding Sundays and public holidays) and 24 hour operation for up to 60 days per annum (excluding Sundays and public holidays) with no more than 4 consecutive days at any time. Council and EPA approved emergency work excepted.

Operating hours for the quarry which is owned by Ballina Shire Council and currently operated by Lismore City Council is Monday to Friday 7am – 5pm, Saturday 7am - 3pm.

3 EXISTING BACKGROUND NOISE LEVELS

3.1 Background Noise Monitoring Method

Background noise monitoring was conducted with calibrated noise equipment monitoring in the side yard of 93 Tanamera Drive Alstonville for a period of 14 days from 5pm Wednesday 16th January to 4pm Wednesday 30th January 2013 for the Development Application for the previous proposed residential dwelling in the NW corner of the lot. This location was chosen as it close to the previously proposed NW building site and in a secure location. This location is 200m north of the new proposed building site in the SW corner.

A Bruel & Kjaer outdoor microphone kit was fitted to the microphone and placed on a 1.5m high tripod. A remote cable was connected to the microphone and the control unit placed in a secure location. The microphone was located as far as practical away from trees and the main indoor living areas of the residential dwelling. The sound level meter was calibrated before and after each measurement period and showed no significant system drift.

Instrument	Serial #	Calibration Date
Brüel and Kjær 2250 Sound Level Meter	2449940	April 2012
Brüel and Kjær Acoustical Calibrator model 4231	2263303	April 2012

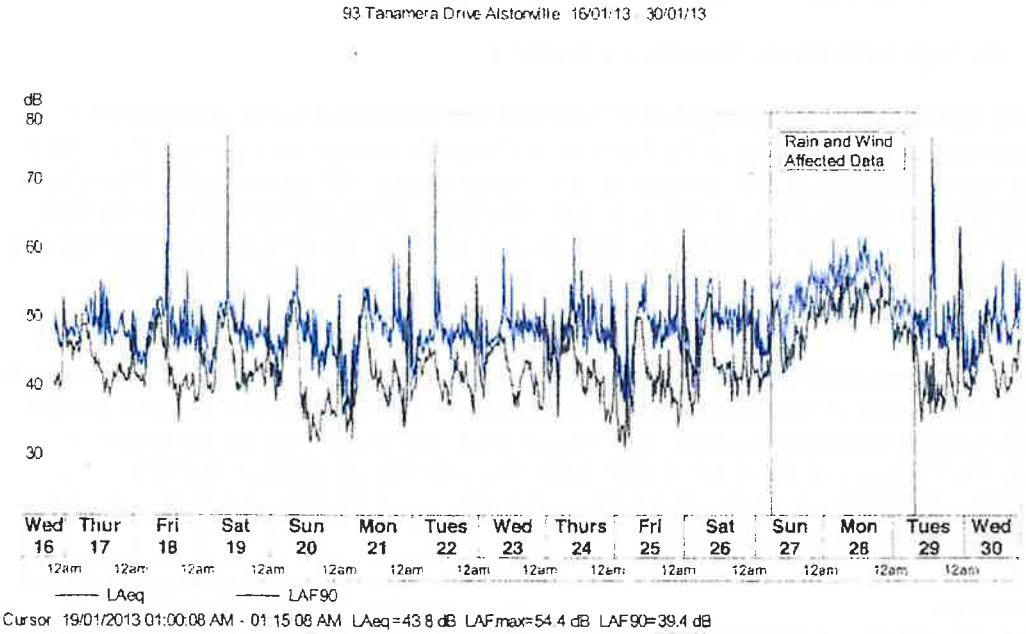
3.2 Results of Background Noise Monitoring

The Rating Background Level (RBL) for the day, evening and night periods was calculated with the Long Term Method procedure outlined in section B1.3 in Appendix B of the NSW Industrial Noise Policy (INP). Data that was affected by adverse weather conditions were deleted from calculations. The results are presented in the following table.

Table 3.1 Measured Noise L_{A90} Levels at 93 Tanamera Drive, Alstonville 16/01/13 – 30/01/13

Daily Assessment Background Levels - Measured at 93 Tanamera Drive Alstonville January 2013 (All levels dBA)																
Period	Wed 16	Thurs 17	Fri 18	Sat 19	Sun 20	Mon 21	Tues 22	Wed 23	Thurs 24	Fri 25	Sat 26	Sun 27	Mon 28	Tues 29	Wed 30	RBL
D 7am-6pm	na	39.6	39.5	39.5	32.0	38.0	37.5	38.4	38.8	37.5	39.4	na	na	38.2	39.5	38.2
E 6pm-10pm	39.8	40.5	37.5	40.2	35.4	39.9	36.7	36.6	32.5	35.0	39.6	na	na	37.9	na	36.6
N 10pm-7am	44.0	40.5	39.3	38.1	33.7	39.7	39.8	41.9	32.3	37.4	40.7	na	na	39.5	na	39.6

Graph 3.1 Logged Noise Levels at Side Yard of 93 Tanamera Drive Alstonville 16/01/13 – 30/01/13 All levels in decibels



3.3 Discussion of Results of Background Noise Monitoring

The weather for the background measurements were generally good for most of the period but there were approximately 2 days towards the end of the monitoring period where data had to be discarded due to heavy rain and excessive wind. The measured data in Table 3.1 includes some quarry and asphalt plant operation. On Sunday the 20th (no quarry or asphalt plant operation), the background noise level was at its lowest of 32.0 dBA.

It was noted during site visits that sometimes seasonal summer cicadas contributed greatly to the L_{Aeq} and L_{A90} levels, particularly in the late evening and the night time periods.

Ambience Audio Services has conducted considerable background noise monitoring in similar acoustic environments in the local area and results indicate that background noise levels would be below 30 dBA for the night time period and late evening without cicadas.

Based on the measured data and other measurements Ambience Audio Services has conducted in similar acoustic environments it is estimated that the Rating Background Level for the day time would be 33 dBA. A comparison of background noise levels by different acoustic consultants that have conducted noise monitoring near the quarry is given in Table 3.2 below.

Table 3.2 Comparison of Background Noise Levels
(All levels dB L_{A90})

Report	Acoustics Report for DA	Hyder Consulting	Heggies Australia	Ambience Audio Services
Date	1995	Sept 2004	June 2005	Jan 2013
Location	Residential areas away from Teven Rd	Granada Pde	Granada Pde	93 Tanamera Drive
Day	33	36	35 – 37*	33
Evening	n/a	31	35 – 37*	<30
Night	n/a	<30	34 - 36*	<30

* Range of values - Uncertain from wording in report

4 PREDICTED ASPHALT AND QUARRY NOISE LEVELS

Acoustic measurements were conducted at the proposed SW building site to determine the amount of noise from the asphalt plant operations on the proposed new dwelling. It was observed from previous noise monitoring during the day it is difficult for accurate measurement of the contribution of the asphalt plant and quarry noise at this location due to road traffic noise on Teven Road and general neighbourhood noise such as mowers, whipper snippers and leaf blowers. Measurements from the previous noise study has been included in this section

The asphalt plant noise monitoring was conducted at night time to isolate the noise level of the asphalt plant from the quarry operations and to measure the asphalt plant in quieter conditions. The quarry was measured during the day when the asphalt plant was not operating. Markers were used on the sound level meter during the noise monitoring to identify other acoustical events for later calculations and evaluations.

Several other noise studies have been conducted by other acoustic consulting firms to assess night time noise impacts from the asphalt plant at nearby residential receivers. A review of two of these noise studies and data that is useful for this location are presented in Section 4.2 in this report.

4.1 Measurement of Asphalt Plant and Quarry

4.1.1 Measurement Procedures

Table 4.1 Instrumentation for Noise Monitoring – 2013

Instrument	Serial #	Calibration Date
Brüel and Kjær 2250 Sound Level Meter	2449940	April 2012
Brüel and Kjær Acoustical Calibrator model 4231	2263303	April 2012

Table 4.2 Instrumentation for Noise Monitoring – 2014

Instrument	Serial #	Calibration Date
Brüel and Kjær 2250 Sound Level Meter	2449940	April 2014
Brüel and Kjær Acoustical Calibrator model 4231	2263303	Dec 2013

The sound level meters (SLM) used during the noise surveys conform to Australian Standard 1259 "Acoustics - Sound Level Meters", (1990) as a Type 1 precision sound level meters and have an accuracy suitable for both field and laboratory use. The meters' calibrations were checked before and after the measurement periods with a Brüel and Kjær acoustical calibrator model 4231. No significant system drift occurred over the measurement periods.

The SLMs and calibrator have been checked, adjusted and aligned to conform to the Brüel and Kjær factory specifications and issued with conformance certificates. The internal test equipment used is traceable to the National Measurement Laboratory at CSIRO, Lindfield, NSW.

Measurements were made in general accordance with procedures laid down in:

1. **Australian Standard AS 1055.1-1997: 'Acoustics** - Description and measurement of environmental noise - General procedures';

2. **The NSW Government Industrial Noise Policy (2000) EPA 00/1 (INP).**

Measurement Procedure 2013 Noise Survey

The 2250 SLM was mounted on a 1.4m high tripod and a Bruel and Kjær outdoor microphone kit fitted to the microphone. The SLM was located at the proposed NW corner building site on the lot to record asphalt plant and quarry operations while they were operating under load conditions. Both the quarry and asphalt plant would not allow a sound level meter to be located on site to record reference noise levels while the plants were under operating conditions. Phone calls were used to coordinate between each of the plant supervisors indicating that the each facility was operating under typical load conditions.

The measurements were recorded over 15 minute periods with 1 second logging. Markers were used during some of the noise monitoring periods to identify the noise levels and duration of acoustic events for later analysis.

Measurement Procedure 2014 Noise Survey

The 2250 SLM was mounted on a 1.4m high tripod and a Bruel and Kjær outdoor microphone kit fitted to the microphone. The SLM was located at the proposed SW corner building site on the lot to record asphalt plant operations while operating under load conditions. The asphalt plant would not allow a sound level meter to be located on site to record reference noise levels while the plant was under operating conditions. Phone calls were used to coordinate between the plant supervisor to inform of the operating conditions at the asphalt plant.

The measurements were recorded over 15 minute periods with 1 second logging. Markers and sound recordings were used during the noise monitoring to identify the noise level and duration of acoustic events for later analysis.

4.1.2 Weather Conditions

Weather conditions for the attended blast, quarry and asphalt plant measurements were generally good and presented in Table 4.3 below.

Table 4.3 Weather Conditions During Attended Noise Monitoring

Date	Time	Measurement	Temp (°C)	Humidity (%RH)	Wind Direction	Wind Speed (m/s)	Cloud Cover
15/01/13	10:45pm	Asphalt Plant	21	75	ESE	<0.5	
07/02/13	2:15pm	Blast	27	55	East	2.5 -4.0	4/8
17/04/13	9:45am	Quarry	23	70	SE	<0.5	1/8
02/06/14	10:30pm	Asphalt Plant	19	85	n/a	calm	0/8

4.1.3 Measurement Results

Table 4.4 NW Corner Asphalt Plant Results 15/01/13

		Total,15min					
Operation	Start Time	L_{Aeq}	L_{AFMax}	L_{AF10}	L_{AF90}	L_{Ceq}-L_{Aeq}	Notes
Asphalt Plant	10:28pm	41.7	62.5	41.7	38.8	12.0	Loader quite audible Asphalt plant audible Occasional car Teven Rd Cicadas quite audible and consistent Occasional dog barking
Background	10:46pm	41.5	63.6	39.8	36.2	5.1	Neighbourhood noise Distant traffic Pacific Hwy Birds, frogs, Cicadas quite audible and consistent
Background	11:02pm	41.7	61.9	38.9	36.7	4.4	Local traffic Distant traffic Pacific Hwy Birds, distant dog, distant cattle Cicadas quite audible and consistent

Table 4.5 NW Corner Quarry Operations 17/04/13

Measured Quarry Noise Levels at Proposed Building Site 17/04/13									
		Total,15min							
Operation	Start Time	L_{Aeq}	L_{AFMax}	L_{AF10}	L_{AF90}	$L_{Ceq-LAeq}$	$L_{Aeq\ 80Hz}$	$L_{Aeq\ 100Hz}$	Notes
Quarry	9:27am	43.9	55.7	45.5	41.3	12.5	25.3	31.1	80Hz & 100Hz constant tone from quarry Quacker reversing alarm just audible 2kHz tone consistent from neighbour approx 32-35 dBA Local traffic Greenie Drive & Teven Rd Occasional dogs barking Distant overhead aircraft Unidentifiable consistent 16kHz 20kHz tone approx 30 – 38 dBA – not audible but observed in spectrum
Quarry	9:46am	43.5	55.6	45.1	41 0	14 1	29 7	32.9	80Hz & 100Hz constant tone from quarry Quacker reversing alarm just audible Local traffic Greenie Drive & Teven Rd Birds Unidentifiable consistent 16kHz & 20kHz tone approx 30 – 38 dBA – not audible but observed in spectrum
Quarry	10:01am	42.8	60.0	44.3	39.6	13.8	28 1	31.1	80Hz & 100Hz constant tone from quarry Quacker reversing alarm just audible Local traffic Greenie Drive & Teven Rd Birds Several loud bangs from quarry – possible tailgate - approx 45 - 50 dBA Unidentifiable consistent 16kHz & S20kHz tone approx 30 – 38 dBA – not audible but observed in spectrum

Table 4.6 Blast Results

Date	Location	Air Blast Over-pressure L_{LPeak} (dB) LIMIT 115dB(L)	Ground Vibration, Peak Particle Velocity (mm/sec) LIMIT 5mm/sec
07/02/13	Proposed Building Site	111.9	na
07/02/13	Rear 1358 Teven Road	106.0	1.27
28/08/13	Monitor 1 (260m)	113.3	4.29
28/08/13	Monitor 2 (655m)	105.6	0.635
28/08/13	Monitor 3 (684m)	106.0	0.794
28/08/13	Monitor 4 (410m)	101.9	0.984

*Monitor 2 – Rear of residential dwellings in Tanamera Drive (approx 75m from Previous NW Building Site)

Table 4.7 NW Corner Asphalt Operations 02/06/2014

Summary of Asphalt Plant Measurements 02/06/2014				
Measurement Location and Measurement Number	**SW 1**	**SW 2**	**SW 3**	**NW**
Time	10:16pm	10:32pm	10:52pm	11:19pm
Total $L_{Aeq,15min}$ dB(A)	37.6	37.5	35.2	33.5
Asphalt $L_{Aeq,15min}$ dB(A)	34.8	35.5	34.7	31.9
Asphalt L_{Aeq} Difference Between SW and NW (dB)	2.9	3.6	2.8	
$L_{A90,15min}$ dB(A)	33.5	33.3	33.4	29.2
$L_{A90,15min}$ Difference Between SW and NW (dB)	4.3	4.1	4.2	

The asphalt plant was the dominant noise source during the 02/06/2014 night measurement. The background noise sources during the June 2014 measurements consisted of occasional traffic on Teven Road, occasional asphalt trucks on Teven Road, distant overhead aircraft, distant barking dog. The audible noise from the asphalt plant was a consistent low frequency (40 – 100Hz) noise that was verified by driving to the entrance of the asphalt plant and confirming that the low frequency noise was coming from the asphalt plant location.

4.2 Previous Noise Studies

Hyder Consulting Australia conducted a noise impact assessment in September 2004 (Report date Oct 2004) for Boral Asphalt to operate the asphalt plant for a limited number of 24 hour operations per year. The assessment was conducted under the NSW Industrial Noise Policy. Heggies Australia conducted a noise compliance assessment of the asphalt plant in June 2005 (Report date 25th Oct 2005) to assess the noise levels from the plant for 24 hour operation during winter months. This assessment also used the NSW Industrial Noise Policy.

A summary of the measured / predicted noise levels are presented following.

Table 4.8 Hyder Consulting Report October 2004.

Closest Residential Receiver in Granada Pde Panorama Estate Alstonville			
Assessment Period	*Rating Background Levels (dBA)*	*Intrusive Criterion (dBA)*	*Asphalt Plant Noise Levels ($L_{A90,15min}$)*
Day (7am – 6pm)	*36*	*41*	*48**
Evening (6pm – 10pm)	*31*	*36*	*40*
Night (10pm – 7am)	*<30#*	*35*	*35*

**Includes quarry noise*
#DEC recommends that levels below 30 dB(A) are taken as 30dB(A)

Table 4.0 Heggies Noise Compliance Measurements Alstonville Asphalt Plant Report 25/10/2005 – 214 Teven Road Alstonville.

Date/ Start Time	*Weather*	*L_{Aeq} (dBA)*	*Asphalt Plant L_{Aeq} Contribution (dBA)*
5/06/05 8:18	*Calm*	*52*	*44*
5/06/05 9:08	*Calm*	*52*	*44*
18/06/05 17:10	*Calm*	*45*	*45*

Table 4.10 Heggies Noise Compliance Measurements Alstonville Asphalt Plant Report 25/10/2005 – 23 Granada Pde Alstonville.

Date/ Start Time	*Weather*	*L_{Aeq} (dBA)*	*Asphalt Plant L_{Aeq} Contribution (dBA)*
5/06/05 8:54	*Calm*	*42*	*41*
5/06/05 9:35	*Calm*	*44*	*42*
18/06/05 15:10	*Calm*	*45*	*41*

Table 4.11 Heggies Noise Compliance Measurements Alstonville Asphalt Plant Report 25/10/2005 – Impact Analysis

Location	*Period*	*Estimated Asphalt Plant Contribution ($L_{Aeq,15mins}$)*	*Project Specific Noise Criteria ($L_{Aeq,15mins}$)*	*Compliance with Criteria*
214 Teven Road	*Day*	*44*	*42*	*Yes*
	Evening	*44*	*42*	*Yes*
	Night	*44*	*41*	*No*
Granada Pde	*Day*	*41*	*42*	*Yes*
	Evening	*41*	*42*	*Yes*
	Night	*41*	*41*	*Yes*

5 NOISE CRITERIA

5.1 EPA Licence Noise Criteria

The asphalt plant and quarry currently operate under separate Environmental Protection Licences (EPL) issued by the NSW Environment Protection Authority. The relevant sections are reproduced in Appendix E.

EPL 959 is held by Bitupave, PO Box 63 Toongabbie NSW 2146, for the asphalt plant at Gap Road Alstonville. The noise limits specified in condition L6.1 are reproduced below.

L6.1 Noise from the premises must not exceed the limits as set out in Table 1.

Table 1.

Location	Evening $L_{Aeq(15min)}$	Night $L_{Aeq(15min)}$
214 Teven Road*	N/A negotiated agreement in place	
29 Granada Parade	38 dB(A)	35 dB(A)
81 Teven Road	38 dB(A)	35 dB(A)

* Note: Negotiated agreement in place between the owner and occupier of 214 Teven Road and the licensee.

It would be expected that the evening noise limit of 38 dB $L_{Aeq,15min}$ and the night time limit of 35 dB $L_{Aeq,15min}$ would apply to residential dwellings in Tanamera Drive.

Ballina Shire Council has specified in the Conditions of Consent for DA 1995/127 (amended 27 May 2008 – Condition 2a) the operating hours of the asphalt plant and are reproduced below.

2a Activities carried out on the land and road systems pursuant to this consent shall only be undertaken between 6.00 am to 6.00 p.m. Monday to Saturday inclusive (excluding Sundays and public holidays except for emergency work with approval from Council and the DECC); and 24 hour operation for up to 60 days per annum (excluding Sundays and public holidays except for emergency work with approval from Council and the DECC). 24 hour operations are not to be conducted for more than 4 consecutive days at any time.

81 Teven Road is approximately 100m to the south east of the proposed building site. The asphalt plant is approximately 460m north-east from 81 Teven Rd and approximately 470m north-east from the proposed building site in the SW corner of the lot.

EPL 3856 is held by Lismore City Council, PO Box 23A Goonellabah NSW 2480, for Tuckombil Quarry at 486 Gap Road Alstonville. The noise limits specified on the current license are reproduced below.

L4 Noise limits

L4.1 Noise from the licensed premise must not exceed an LAeq (15 minute) noise emission criterion of 38, except as expressly provided by this licence.

L4.2 Noise from the premises is to be measured at the most affected residential receiver to determine compliance with this condition.

L5 Blasting

L5.1 Blasting operations at the premises may only take place between 9:00 a.m. to 15:00 Monday to Friday. (Where compelling safety reasons exist, the Authority may permit a blast to occur outside the abovementioned hours. Prior written (or facsimile) notification of any such blast must be made to the Authority).

L5.2 The airblast overpressure level from blasting operations in or on the premises must not exceed:

a) 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period; and
b) 120 dB (Lin Peak) at any time.

At at any point within 1 metre of any affected dwelling unless the dwelling is subject to a private written agreeement

L5.3 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:

a) 5 mm/s for more than 5% of the total number of blasts carried out on the premises during each reporting period; and
b) 10 mm/s at any time.

At within 1 metres of any residential dwelling unless the dwelling is subject to a private written agreeement

L5.4 All sensitive recievers are to begiven at least 24 hours notice when blasting is to be undertaken.

Section 4.2 of the Draft Environmental Management Plan for Tuckombil Quarry (August 2012) is reproduced below.

4.2 Noise Management

Responsible Person	Quarry Manager
Management controls	1. Traffic movements and work hours will be limited to 7:00am and 5.00pm Monday to Friday and 7.00am and 3.00pm on Saturday. 2. Management will be aware of site conditions and appropriate steps will be taken when necessary to control the noise generation from site operations.
Monitoring	• Regular visual site monitoring by quarry manager for particularly noisy activities.
Corrective Action	Where necessary, the source of offending noise will be identified and appropriate actions taken, including altering the time of day that the activity is undertaken to minimise impact to neighbouring properties.

Reporting to Council will only be required following complaints by residents when follow up is required. and/or when the Environmental Audit is due.

5.2 NSW Industrial Noise Policy (2000)

Ballina Shire Council has specified that the proposed residential dwelling with be required to comply with the noise criteria in the New South Wales Industrial Noise Policy.

The NSW Government via the Office of Environment and Heritage (formally EPA) provide criteria in the Industrial Noise Policy (INP) for industrial and commercial noise. These are generally in line with criteria given in other states of Australia. This covers noise in urban, suburban and rural areas.

5.2.1 Intrusive Noise Goal

The intrusiveness criterion is summarised as follows:

$L_{Aeq,15minute} \leq$ *rating background level plus 5 decibels.*

This means that the equivalent continuous (energy average) A- weighted sound pressure level of the noise source under investigation over 15 minutes, cannot be more than 5 decibels above the background noise level.

5.2.2 Amenity Noise Goal

Amenity noise goals are set to prevent an increase in industrial noise. This site would be considered suburban under the NSW Industrial Noise Policy. The intrusive and Acceptable Noise Level (ANL) for this site is given in Table 5.1.

Table 5.1 Intrusive and Amenity Noise Goals

	Monday – Saturday	Sunday & Public Holidays	Intrusive	Amenity	
			RBL (dBA)	Acceptable $L_{Aeq,15min}$	Maximum $L_{Aeq,15min}$
Day	7.00am – 6.00pm	8.00am – 6.00pm	38	55	60
Evening	6.00pm – 10.00pm	6.00pm – 10.00pm	35	45	50
Night	10.00pm – 7.00am	10.00pm – 8.00am	35	40	45

5.2.3 Modifying Factors

When a noise source contains certain characteristics, there is evidence to suggest that it can cause greater annoyance than another noise source at the same noise level. Table 4.1 of the NSW EPA Industrial Noise Policy (Jan. 2000) outlines the noise characteristics and the modifying factor corrections. Data from the acoustic measurements at the receiver locations was analysed for noise characteristics. No tonality, low frequency, impulsive or intermittent noise characteristics were observed.

5.2.4 Project Specific Noise Goal (Proposed Building Site)

Project or site-specific noise goals (PSNG) are set on the basis of the most stringent applicable criteria given above. The maximum noise levels (dB $L_{Aeq,15min}$) from the asphalt and quarry operations at the proposed building site are given in Table 5.2.

Table 5.2 Maximum Noise Levels from Quarry and Asphalt Plant at SW Corner Building Site

Assessment Period	PSNG dB $L_{Aeq,15min}$	Reason
Day	38	Intrusive Rule
Evening	35	Intrusive Rule
Night	35	Intrusive Rule

6 DISCUSSION OF RESULTS AND ASSESSMENT

6.1 Asphalt Plant

The loader and asphalt plant were audible during the night time measurement (15/01/13) at the NW corner. Cicada noise (3.15kHz and 4kHz) was quite audible and consistent and added to the L_{Aeq} and L_{A90} levels. It was estimated based on the L_{A90} spectrum comparison that the asphalt plant is approximately 35 decibels $L_{Aeq,15min}$ at the previously proposed NW building site.

Night time measurements on the 02/06/14 at the NW corner indicate an L_{Aeq} of 32 decibels at the previously proposed NW building site. It is possible the 3 decibel difference may be due to the slight ESE breeze on the 15/01/13.

The measured asphalt plant noise levels at the SW corner building site on the night of the 2nd of June 2014 (Table 4.7) indicate a consistent 34.8, 35.5 and 34.7 dB $L_{Aeq,15min}$ noise level from the asphalt plant for the 3 observed measurements. It was noted that the asphalt plant was the dominant noise source in the absence of occasional traffic, overhead aircraft and animals.

The results of the measurements on the night of the 2nd of June 2014 under the same meteorological and plant operating conditions, indicate that the asphalt plant noise levels are approximately 3 decibels louder at the proposed SW corner building site compared to the previous NW building site. This can be attributed to an earth bund and stockpiles on the western side of the quarry which reduces noise levels to the previous NW corner building site to the west of the asphalt plant.

The results of the compliance noise monitoring conducted by Heggies in 2005 at 23 Granada Pde which is to the south of the asphalt plant (320m to quarry boundary, 430m to asphalt plant), indicate that the noise levels were 41 dB(A) $L_{Aeq,15min}$ for the night time operations. It is uncertain if the asphalt plant has undertaken noise mitigation works since the report.

6.2 Quarry Operations

The quarry operations were not measured at the new SW building site due to several factors.

1) It was observed during previous noise studies at this location that noise monitoring of the quarry operations during the day were difficult due to road traffic noise on Teven Road and general neighbourhood noise.

2) Since the previous noise study, there has been a variation to the Environment Protection Licence (EPL 3856) held by the quarry operator, Lismore City Council. The variation to the EPL on the 30/01/2014 included noise limits for quarry operations at Tuckombil Quarry. Previously there were no noise limits on EPL 3856. Conditions L4.1 and L4.2 require that noise from the licensed premise must not exceed an L_{Aeq} (15 minute) noise emission criterion of 38 (except as expressly provided by the licence) when measured at the most affected residential receiver.

3) Additional cost to the applicant after noise impact assessment for previously proposed NW corner building site on the same lot.

Measurements from the previous noise study estimated that quarry operations were approximately 35 dB(A) at the previously proposed NW corner building site. The quarry operations were observed to have an 80Hz and 100Hz tone. The reversing quacker on the loader was just audible. There was an unidentifiable 2kHz tone from a nearby neighbour's yard for all of measurement 1 and part of measurement 2 of the day time quarry measurement. There was also an inaudible unidentifiable 16kHz and 20kHz tone which contributed to the L_{Aeq} and L_{A90} levels. Based on the 80Hz and 100Hz frequencies, it is estimated that the quarry operations are approximately 35 dBA $L_{Aeq,15min}$ at the previously proposed NW building site.

It is estimated that quarry noise levels would be below 38 dB $L_{Aeq,15min}$ at the proposed SW building site for the following reasons:

1) Asphalt plant noise levels were approximately 3 decibels louder at SW corner building site compared to NW building site. The crushing and screening quarry operations are conducted on the quarry pit floor (asphalt plant has noise sources above the natural ground level) and there would be an increase in noise reduction from the pit walls for receiver locations to the SW.

2) The EPA licence (EPL 3856) conditions require the $L_{Aeq,15min}$ to not exceed 38 dB $L_{Aeq,15min}$ at the most affected receiver. There are receiver locations closer to both the previous NW corner building site and the proposed SW corner building site. Any change in operation at the quarry would require noise emissions from the quarry to not exceed the 38 dB $L_{Aeq,15min}$ criteria which would mean that noise levels at the NW and SW building sites would be lower than existing closer affected receiver locations.

The measured asphalt plant noise levels at the proposed SW corner building site are 6 decibels lower than the measured levels by Heggies (25/10/2005) at Granada Pde. It is uncertain if noise mitigation works have been carried out at the asphalt plant after the Heggies compliance report in 2005.

6.3 Blasting

Lismore City Council (current quarry operators) applied to Ballina Shire Council on the 27/07/2012 for a Section96 to modify the consent conditions in the Development Consent conditions. The application is to modify the blast methodology at Tuckombil Quarry.

The application to modify the blast methodology is in response to correspondence from Ballina Shire Council's Compliance Officer to the quarry operators that the provisions of the original report are complied with or alternatively an amendment to the development consent, after non compliance with blasting parameters in 2010 and 2011 and the subject of community complaints.

Lismore City Council (quarry operators) engaged Orica Mining Services to conduct a peer review of the original Blastronics report and recommend changes to the blast methodologies. The Orica review of 4 Blast Summary Records indicated that the previous blast contractor was not following the design parameter recommendations or monitoring locations set out in the original DA conditions. The review also concluded that the impact to nearby neighbours would have been much greater than would have been resultant from the original design parameters and locations.

Orica conducted a test blast to determine the design parameters for drilling, charge weight and delayed firing sequences that would enable future blasts at the quarry to comply with the original blast limit parameters. The design parameters for a blast is based on compliance with the closest receiver at monitor location 1 which is much closer to the quarry pit than the proposed SW building site.

The new blast methodology has been adopted by the quarry operators and two blasts have been conducted since – 07/02/13 and 28/08/13. The results indicate compliance at the monitoring locations near the proposed dwelling site.

As part of the updated Tuckombil Quarry Environmental Management Plan, two permanent monitors have been installed near residential receivers. Two local community liaison representatives will be provided with copies of the Pre-Blast Design Parameters and the Post-Blast Monitoring Results.

The new Orica blast method with delayed electronic firing sequences, continual review and appraisal of each blast, two permanent monitoring locations and the addition of community representatives to the monitoring and overseeing of the blast will assist the quarry operators to comply with the blast noise limits at residential receivers.

6.4 Meteorological Conditions

The monthly wind roses (28/02/1968 – 28/02/2010) for the Alstonville Agricultural Research Station (Bureau of Meteorology site No. 058131) approximately 1800m to the south east of the proposed building site) were analysed for prevailing wind less than 3m/s for more than 30% of the time.

The 9am and 3pm data from the Ballina Airport site (approximately 10kms to the east) was also analysed. The data from the Ballina Airport site was determined to be not representative of the proposed building site as the wind strengths were much higher than the Alstonville site.

The Alstonville site only had data available for the 9am period. The 9am data indicates prevailing wind of less than 3m/s for more than 30% of the time for June and July. Westerly winds would not increase noise from the asphalt plant and quarry at the proposed building site.

It is known that north east and easterly afternoon ocean breezes occur at this site during summer. It is predicted that there would be a 3 – 5 decibel increase of asphalt plant and quarry noise levels at the proposed SW building site and equally to the nearby existing residential dwellings to the west.

7 NOISE MITIGATION MEASURES

The subject property has an area of 5.624 hectares with a dwelling entitlement. Noise mitigation methods have been considered and included in the design of the proposed dwelling to reduce noise and vibration impacts from quarrying and blasting at Tuckombil Quarry and operations at the associated asphalt plant. These noise mitigation methods include:

7.1 Location

The proposed residential dwelling has been located in the south-west corner of the lot and is one of the furthest locations on the 5.624 hectare lot from the quarry. The eastern facade of the proposed dwelling (closest to quarry) is 35 metres from the existing dwellings in Tanamera Drive.

The proposed SW building site is approximately 210 metres to the quarry boundary, approximately 470 metres to the asphalt plant and over 600 metres to the current quarry pit operations (crushing, screening).

7.2 Layout

The asphalt plant currently has consent to operate for up to 60 nights per year. The building plan for the proposed dwelling indicates that bedrooms 1 and 2 are located on the southern and western sides of the dwelling and have openable on the opposite side to the asphalt plant noise source. The openable window in bedroom 3 is in the same direction as the asphalt plant but is partly shielded from the noise by the garage. It is generally accepted that a partially open window for adequate ventilation will reduce external noise levels by 10 decibels.

Asphalt plant noise levels during night periods for bedroom 3 will be approximately 28 dB(A) (7 decibels lower than the outside noise level of 35 dB(A) - facade level is 2.5 dB higher than free field). The internal noise levels in the bedrooms on the opposite side to the quarry for partially open windows are expected to be less than 25 dB(A).

The living / dining area has an openable window on the opposite side to the asphalt plant. The family room openable sliding door is on the same side as the quarry but is partly shielded by the garage.

The internal noise levels from the asphalt plant during the evening and night time periods will meet the requirements of AS/NZS 2107:2000 - Sleeping Areas - Satisfactory 30dB (A), Maximum 35 dB(A) and Living Areas – Satisfactory 30 dB(A), Maximum 40 dB(A) for houses and apartments near minor roads. All values L_{Aeq}. Windows tend to be kept closed during winter months which will reduce internal noise further.

The garage has been located on (quarry side) of the proposed dwelling.

7.3 Construction Materials

The building plan indicates brick veneer walls, colorbond metal roof sheeting/insulation/ plasterboard ceiling and concrete slab. The glazing specification is for standard glazing with standard seals.

The Orica Report identified that the limits for blast vibration that most quarry operators and government agencies work to regarding vibration and noise from blasting, are based on human comfort factors and that these comfort limits are significantly less than the levels that would be required to produce even cosmetic damage to nearby residential homes or commercial structures. Airblast pressures in excess of 133 dB(L) were identified as potential damage levels.

Based on the results of airblast pressure, of the new blast methodology, of 111.9 and 105.6 dB(L) near the proposed building site and a limit of 115 dB(L) 95% of blasts max 120 dB(L) 5% at the closest residence approximately 200 metres closer to the quarry , the proposed construction materials will be adequate.

Asphalt plant noise levels during the quieter spring and autumn evenings and night inside the dwelling with widows partially open would be expected to be approximately 7.5 decibels lower than the outside noise level (facade level is 2.5 dB higher than free field) and would meet the requirements of AS/NZS 2107:2000 of 30dBA L_{Aeq} for sleeping and living areas for houses and apartments near minor roads.

8 SUMMARY AND CONCLUSION

An acoustic assessment of a proposed new residential dwelling at Lot 2 DP 800081 Greenie Drive Alstonville NSW 2478 was undertaken to evaluate noise and vibration impacts from a nearby asphalt plant and quarry.

Noise monitoring was conducted over a 2 week period with calibrated noise monitoring equipment near the proposed building site to determine background noise levels. The Rating Background Level was determined to be 33 dBA for the day time period and 30 dBA for the evening and night time periods after evaluation of seasonal insects were taken into account. The Project Specific Noise Goal was determined to be 38 dBA $L_{Aeq,15min}$ for the day time period (7am-6pm) and 35 dBA $L_{Aeq,15min}$ for the evening (6pm-10pm) and night time (10pm-7am) periods.

Results of noise monitoring of the asphalt plant and quarry at the proposed building site indicate a level of 35 dBA $L_{Aeq,15min}$ for each of the asphalt plant and quarry operations under load conditions for the day time period. It is predicted the combined day time noise level is 38 dBA $L_{Aeq,15min}$ which complies with the PSNG. The noise level of the asphalt plant at the proposed building site is 35 dBA $L_{Aeq,15min}$ which complies with the evening and day time PSNG.

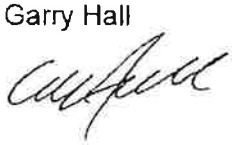
Noise levels from the asphalt plant and quarry may increase at the proposed building site due to changes of operations at the asphalt plant and quarry. These increases will also equally affect the existing residential dwellings 25 – 30 metres to the west of the proposed building site. Similarly, any increase in noise levels at the proposed building site due to meteorological conditions will also have an equal increase at the nearby existing residential dwellings.

Additional quarry related traffic on Teven Road is not considered to have any significant noise impact on the proposed residential dwelling.

Blast over-pressure and ground vibration levels are predicted to be below the allowed limits at the proposed residential dwelling.

Noise levels from the nearby Tuckombil quarry and asphalt operations at the proposed residential dwelling will comply the NSW Industrial Policy.

Garry Hall



Acoustic Consultant
Ambience Audio Services

Referenced Documents and Sources:

Building Plans – Lismore Design & Drafting 24/05/12 – Issue 3

Australian / New Zealand Standard – AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors*

New South Wales Industrial Noise Policy – Jan 2000

New South Wales Environment Protection Authority website – EPL Licence 959 and 3856

Reports

Richard Heggie Associates Pty Ltd – *Tuckombil Quarry Noise Impact Statement – Report 4733-R2* -13/03/1995

Ballina Shire Council - *Form 7 - Notice to Applicant of a Determination of a Development Application DA 1995/276* - 02/11/1995

Hyder Consulting – *Boral Plant Alstonville – Activity Noise Impact Assessment* - October 2004

Heggies Australia – *Compliance Noise Measurements Alstonville Asphalt Plant* – 25/10/2005

Newton Denny Chapelle - *Draft Environmental Management Plan Tuckombil Quarry Alstonville (Section 4.2 Noise Management)* – August 2012

APPENDIX A
Definitions of Terms

Sound pressure level (L_p): A measurable quantity of the size or amplitude of the pressure fluctuations (sound waves) above and below normal atmospheric pressure compared to a reference pressure. Sound pressure levels are measured in decibels whereas sound pressure is measured in pascals (N/m^2).

Decibels (dB): a ratio of energy flows. When used for sound measurement, it is the ratio between a measured quantity of sound pressure and an agreed reference sound pressure. The dB scale is logarithmic and uses the threshold of hearing of 20 μPa (micro pascals) as the reference pressure. This reference level is defined as 0 dB.

Frequency (Hz): The number of pressure variations per second (cycles per second) is called the **frequency** of sound and is measured in **Hertz (Hz)**. The rumble of distant thunder has a low frequency, while a whistle has a high frequency. The normal range of hearing for a healthy young person extends from approximately 20Hz up to 20 000 Hz (20 kHz) while the range from the lowest to highest note on a piano is approximately 27.5 Hz to 4.2 kHz.

Spectral characteristics: The frequency content of noise.

"A" frequency weighting: The method of frequency weighting the electrical signal within a noise-measuring instrument to give a very approximate simulate to the human perception of loudness. The symbols for the noise parameters often include the letter "A" (e.g., L_{Aeq}, dBA) to indicate that frequency weighting has been included in the measurement.

Fast, Slow and Impulse time weightings: Standardised root-mean-square (rms) averaging times to help define fluctuating noise levels. Impulsive noises have high peak levels with a very short duration (e.g., gun shot), or a sequence of such peaks. The 'Slow' time weighting averages the fluctuations over a one second time base whilst the 'Fast' time weighting averages the fluctuations over a one-eighth of a second time base. Environmental assessment standards usually specify the time weighting (**F**, **S**, or **I**) to be used.

L_{Aeq}: The A-weighted equivalent continuous noise level. A widely used noise descriptor which provides an average of the energy of a constant level of noise which is the same as the varying noise signal being measured. The time in minutes, which the measurement was sampled, is indicated with a subscripted number e.g. $L_{Aeq,\ 15\ minute}$ is a 15-minute sample.

L_{AN}: The A-weighted sound pressure level that is exceeded for N per cent of the time over which a given sound is measured. e.g. **L_{A90}** is the A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured.

L_{A90} is commonly used to describe the **background noise level** for community noise assessments.

Ambient noise: The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.

Extraneous noise: Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by events such as concerts or sporting events. Normal daily traffic is not to be considered extraneous.

Background noise: The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor, fast time weighting.

Intrusive Noise: Refers to noise that intrudes above the background level by more than 5 decibels.

Noise limits: Enforceable noise levels that appear in consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.

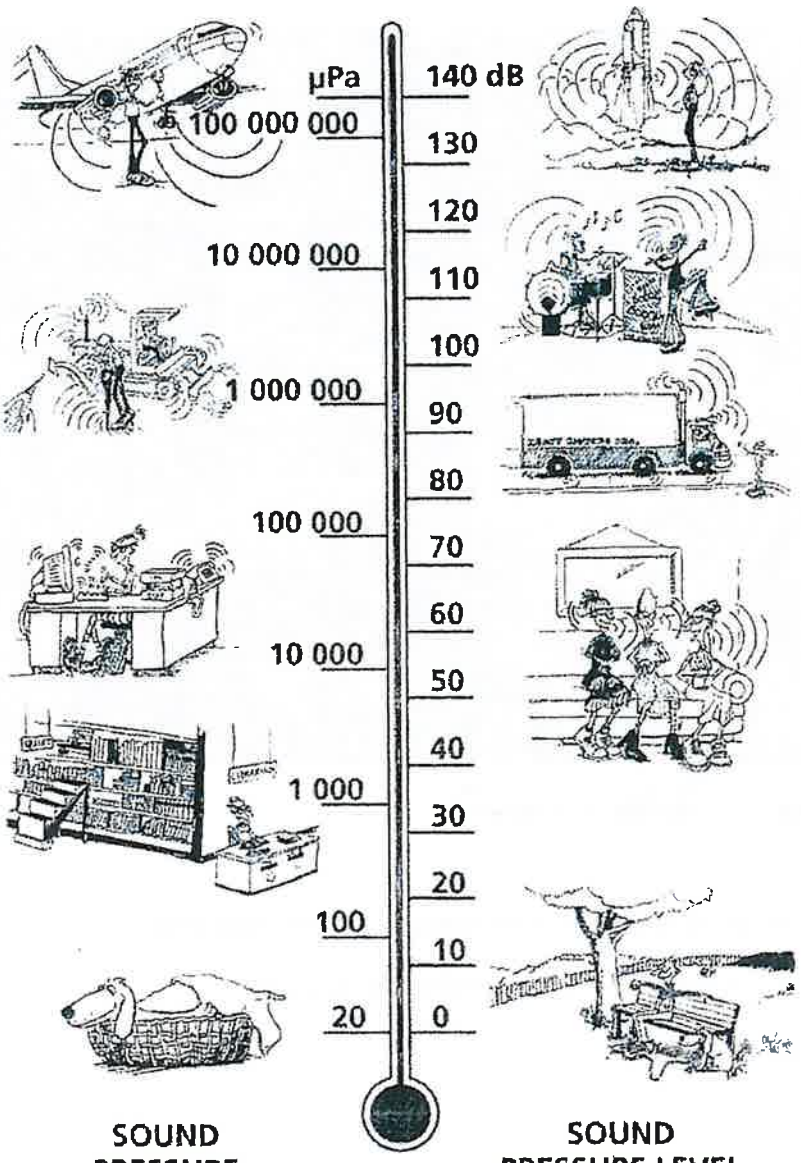
References:

Measuring Sound Brüel and Kjær Sound & Vibration Measurements A/S September 1984

Environmental Noise Brüel and Kjær Sound & Vibration Measurements A/S 2000, 2001

New South Wales Industrial Noise Policy NSW Environment Protection Authority January 2000

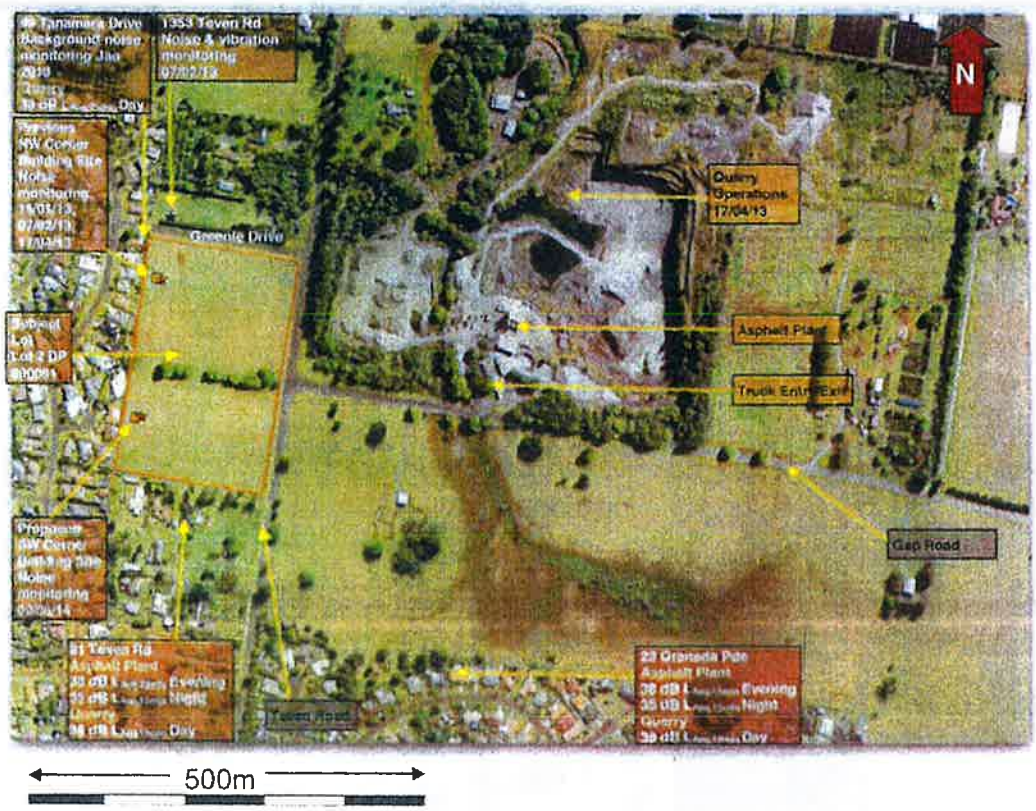
APPENDIX B
Comparison of Sound Pressure Levels



Our hearing covers a wide range of sound pressures – a ratio of over a million to one. The dB scale makes the numbers manageable.

Reproduced from
Environmental Noise Brüel and Kjær Sound & Vibration Measurements A/S 2000, 2001

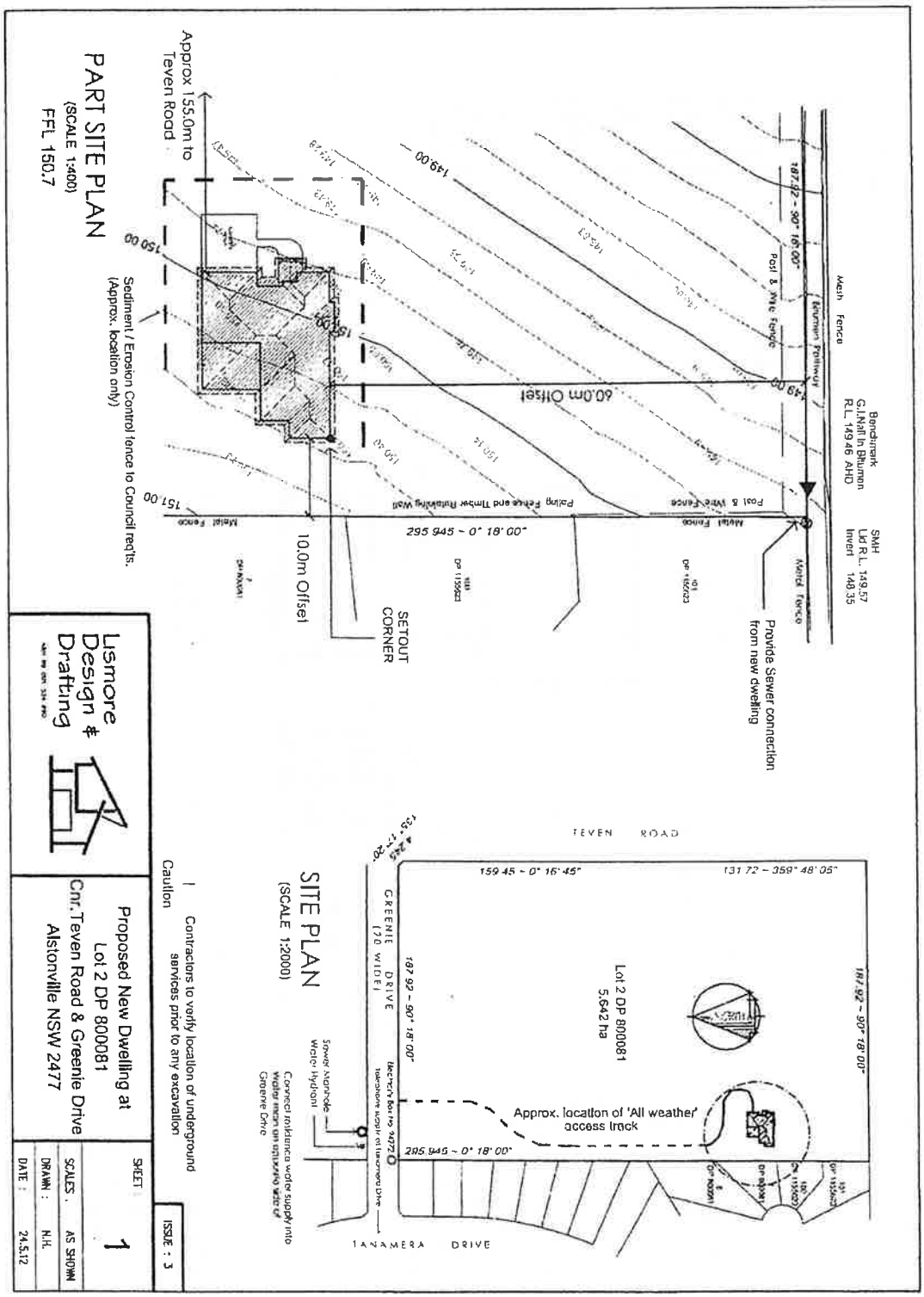
APPENDIX C
Location Map

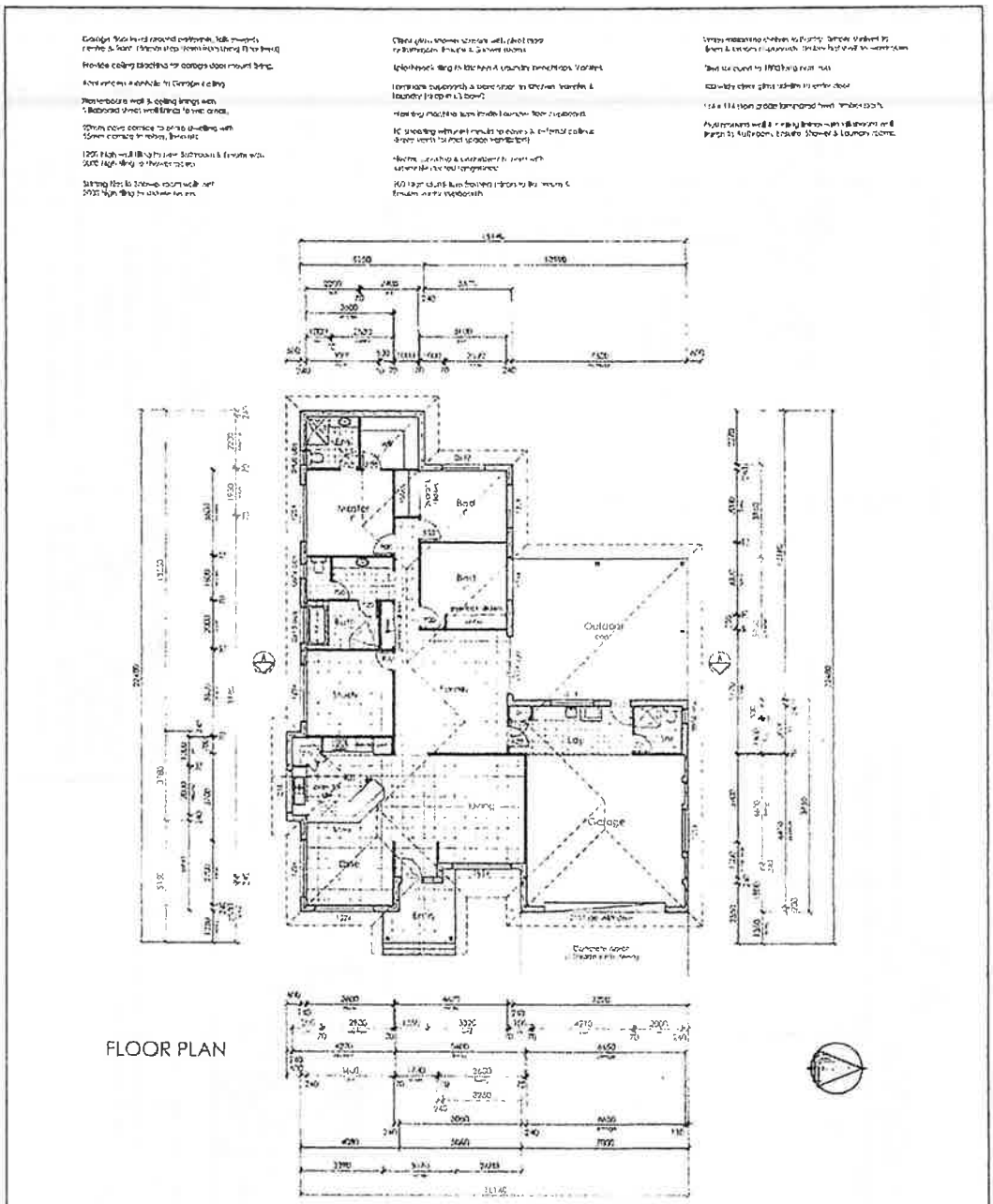


100m

* Ambience Audio Services noise monitoring locations
* Orica noise and vibration monitoring location

APPENDIX D
Building Plans





ISSUE : J

Lismore Design & Drafting

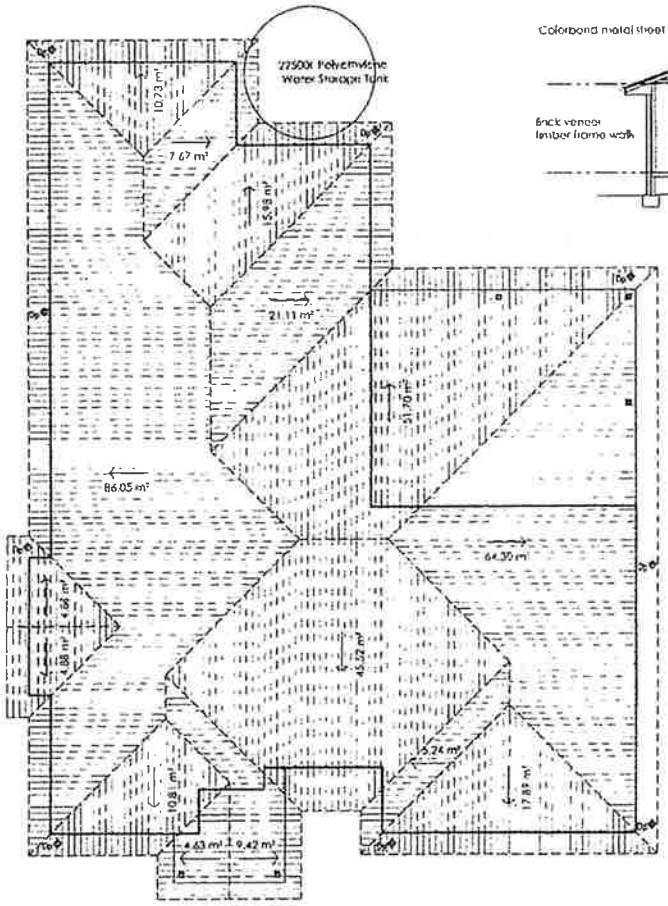
Proposed New Dwelling at
Lot 2 DP 800081
Cnr.Teven Road & Greenie Drive
Alstonville NSW 2477

SHEET 3

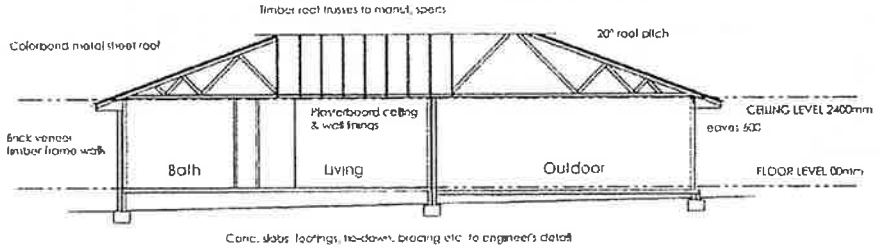
SCALES : 1:100

DRAWN : N.H.

DATE : 24.5.12



ROOF PLAN



SECTION A - A

Colorbond Metal Roof @ 20° pitch

Nominated Roof areas adjusted for roof pitch

Downpipe locations & quantity to be confirmed by plumber (Adjusted as required)

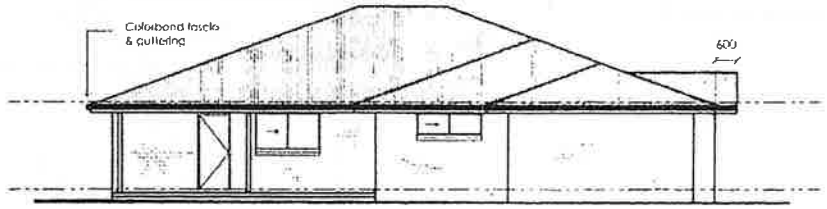
← = Direction of fall & Roof area
21.11 m²

ISSUE : 3

Lismore Design & Drafting

Proposed New Dwelling at
Lot 2 DP 800081
Cnr.Teven Road & Greenie Drive
Alstonville NSW 2477

SHEET :	5
SCALES :	1:100
DRAWN :	N.H.
DATE :	24.5.12



WEST ELEVATION

NORTH ELEVATION

ISSUE : 3

Lismore Design & Drafting

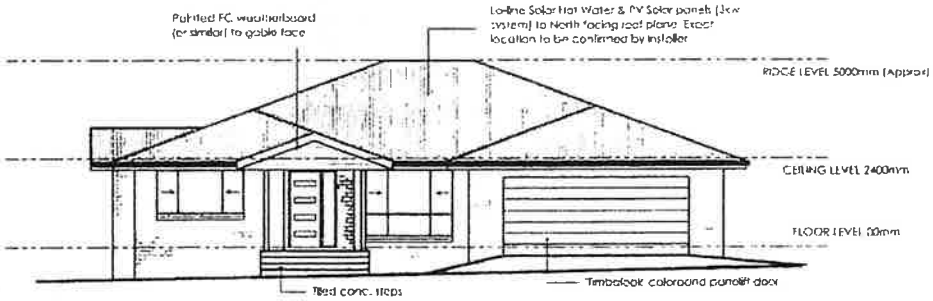
Proposed New Dwelling at
Lot 2 DP 800081
Cnr. Teven Road & Greenie Drive
Alstonville NSW 2477

SHEET : 6

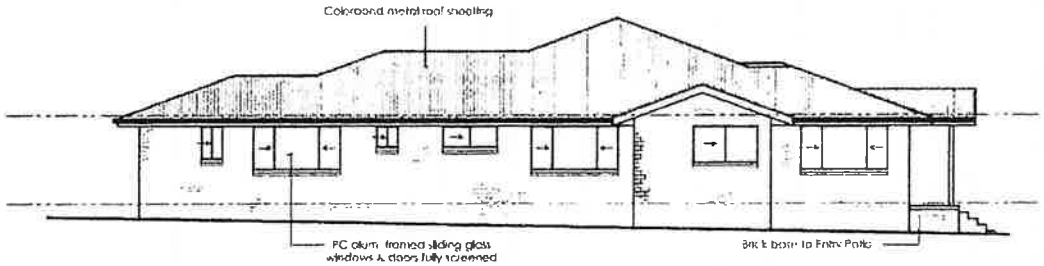
SCALES : 1:100

DRAWN N.H.

DATE : 24.5.12



EAST ELEVATION



SOUTH ELEVATION

ISSUE : 3

Lismore Design & Drafting

Proposed New Dwelling at
Lot 2 DP 800081
Cnr. Teven Road & Greenie Drive
Alstonville NSW 2477

SHEET :	7
SCALES :	1:100
DRAWN :	N.H.
DATE :	24.5.12

APPENDIX E

Environment Protection Licences

E.1 Asphalt Plant Environment Protection Licence

Section 55 Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence - 959

Department of Environment & Climate Change NSW

Licence Details
Number: 959
Anniversary Date: 01-September
Review Due Date: 27-Jun-2010

Licensee
BITUPAVE LTD
PO BOX 63
TOONGABBIE NSW 2146

Licence Type
Premises

Premises
BITUPAVE LTD
GAP ROAD
ALSTONVILLE NSW 2477

Scheduled Activity
Bitumen mixing

Fee Based Activity	Scale
Bitumen mixing	> 30000 - 100000 T produced

Region
North East - North Coast
NSW Govt Offices, 49 Victoria Street
GRAFTON NSW 2460
Phone: 02 6640 2500
Fax: 02 6642 7743

PO Box 498 GRAFTON
NSW 2460

L6 **Noise Limits**

Section 55 Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence 959

L6.1 Noise from the premises must not exceed the limits as set out in Table 1.

Table 1.

Location	Evening $LA_{eq(15min)}$	Night $LA_{eq(15min)}$
214 Teven Road*	N/A negotiated agreement in place	
29 Granada Parade	38 dB(A)	35 dB(A)
81 Teven Road	38 dB(A)	35 dB(A)

* Note Negotiated agreement in place between the owner and occupier of 214 Teven Road and the licensee.

For the purpose of condition L6.1

(a) Evening is defined as the period from 6pm to 10pm

(b) Night is defined as the period from 10pm to 7am Monday to Saturday, and 10pm to 8am Sundays and Public Holidays

L6.2 Where the noise emission limits identified in this license have been exceeded the source should be established and repairs undertaken.

L6.3 To determine compliance with condition L6.1 noise must be measured at, or computed for the affected residences detailed in Table 1. Noise from the premises is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the affected dwelling (rural situations), where the dwelling is more than 30 metres from the boundary.

Where it can be demonstrated that direct measurement of noise from the premises is impractical, the licensee may use alternative means of demonstrating compliance to the EPA, (see Chapter 11 of the NSW Industrial Noise Policy).

A modifying factor correction must be applied for tonal, impulsive or intermittent noise in accordance with the "Environmental Noise Management - NSW Industrial Noise Policy (January 2000)".

L6.4 The noise emission limits identified in condition L6.1 apply under calm meteorological conditions.

E.2 Tuckombil Quarry Environment Protection Licence

Section 55 Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence - 3856

Licence Details
Number: 3856
Anniversary Date: 16-April

Licensee
LISMORE CITY COUNCIL
PO BOX 23A
GOONELLABAH NSW 2480

Premises
TUCKOMBIL QUARRY
486 GAP ROAD
ALSTONVILLE NSW 2477

Scheduled Activity
Extractive Activities

Fee Based Activity	Scale
Land-based extractive activity	> 50000-100000 T extracted, processed or stored

Region
North - North Coast
NSW Govt Offices, 49 Victoria Street
GRAFTON NSW 2460
Phone: (02) 6640 2500
Fax: (02) 6642 7743

PO Box 498 GRAFTON
NSW 2460

Total suspended solids	milligrams per litre	50

L3 Volume and mass limits

L3 1 For each discharge point or utilisation area specified below (by a point number), the volume/mass of:
a) liquids discharged to water; or
b) solids or liquids applied to the area,
must not exceed the volume/mass limit specified for that discharge point or area

Point	Unit of Measure	Volume/Mass Limit
1	kilolitres per day	1500

L4 Noise limits

L4 1 Noise from the licensed premise must not exceed an LAeq (15 minute) noise emission criterion of 38 except as expressly provided by this licence.

L4 2 Noise from the premises is to be measured at the most affected residential receiver to determine compliance with this condition

L5 Blasting

L5 1 Blasting operations at the premises may only take place between 9:00 a.m. to 15:00 Monday to Friday (Where compelling safety reasons exist, the Authority may permit a blast to occur outside the abovementioned hours. Prior written (or facsimile) notification of any such blast must be made to the Authority)

L5 2 The airblast overpressure level from blasting operations in or on the premises must not exceed:

a) 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period; and
b) 120 dB (Lin Peak) at any time

At at any point within 1 metre of any affected dwelling unless the dwelling is subject to a private written agreeement

L5 3 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:

a) 5 mm/s for more than 5% of the total number of blasts carried out on the premises during each reporting period; and
b) 10 mm/s at any time.

At within 1 metres of any residential dwelling unless the dwelling is subject to a private written agreeement

L5.4 All sensitive recievers are to begiven at least 24 hours notice when blasting is to be undertaken.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity.
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

Attachment B Noise Impact Assessment (Muller 2017)

61 Pine Avenue
East Ballina NSW 2478
T | 02 6686 51 83 M | 0448 483 837
tim@timfitzroy.com.au
ABN: 94120188829
ACN: 120188829
www.timfitzroy.com.au

Noise Monitoring Assessment

Alstonville Asphalt Plant

Prepared for : Boral (NSW) Pty Limited

September 2017

MAC

Muller Acoustic Consulting

Document Information

Noise Monitoring Assessment – Alstonville Asphalt Plant

Prepared for: Boral Alstonville

Gap Road

Alstonville NSW 2477

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC170480RP1	Final	12 September 2017	Robin Heaton	Robin Heaton	Oliver Muller	

CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Boral (NSW) Pty Limited to complete a Noise Monitoring Assessment (NMA) for the Alstonville Asphalt Plant, Alstonville, NSW (the "plant"). The NMA has been completed to quantify operational noise emissions of the plant within the surrounding community to ascertain compliance with relevant noise criteria.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA) 2000, Industrial Noise Policy (INP);
- Standards Australia AS 1055.1:1997 - Acoustics - Description and measurement of environmental noise - General Procedures; and
- 160816 Alstonville Asphalt MOD3 Conditions (August 2016).

A glossary of terms, definitions and abbreviations used in this report is provided in Appendix A.

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2 Site Details

The plant is located on Gap Road, Alstonville, NSW and is surrounded by rural and residential land uses. Dwellings in the local area are predominantly residential with traffic noise from Teven Road dominant and local wildlife noise also present.

The plant is used to batch asphalt for use at infrastructure projects within the surrounding area. The process uses raw materials stored onsite and utilises an asphalt burner and bitumen kettles to produce asphalt which is exported from site via road trucks. The plant is enclosed using metal sheeting panels and is at a lower reduced level (RL) than the surrounding receivers.

Four representative residential catchment areas were selected for this assessment and are summarised below:

Location R1 is situated at Calypso Court, Alstonville, NSW, approximately 500m south east of the plant. R1 is representative of residents on Calypso Court and the greater Granada Parade catchment area.

Location R2 is situated on Greenie Drive, Alstonville, NSW, approximately 450m west of the plant and is representative of the Greenie Drive and Tanamera Drive catchment area.

Location R3 is situated at the boundary of 1353 Teven Road, Alstonville, NSW. This location is approximately 430m north west of the site and representative of all receivers to the north of the plant along Teven Road.

Location R4 is situated in the car park of the Alstonville Hockey Club, which is situated 450m to the east of the plant. This location is representative of the receiver catchment to the east of the plant.

The plant, receivers/catchment areas are presented in Figure 1.

FIGURE 1

LOCALITY PLAN

REF: MAC170480

0 100m

KEY

R1 RECEIVER LOCATION

L1 LOGGER LOCATION

SITE LOCATION

MAC
Maher Acoustic Consulting

*Imagery Source: nearmap

3 Background Noise Environment

3.1 Unattended Noise Monitoring

To quantify the existing background noise environment of the area during the day, evening and night-time periods, unattended noise logging was conducted at Greenie Drive, Alstonville. The logger location was selected considering the proximity of nominated receptors to the site and security. The unattended noise survey was conducted in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise".

The measurements were carried out using one Svantek Type 1, 977 noise analyser from Friday 4 August 2017 to Thursday 17 August 2017. Observations on-site identified that the surrounding locality was typical of a residential environment, with noise from traffic on Teven Road and Greenie Drive and general urban hum being dominant sources. Noise from local wildlife and birds, and wind rustling in trees was also audible during the surveys. Drift in calibration did not exceed ±0.5dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Data affected by adverse meteorological conditions have been excluded from the results in accordance with methodologies provided in Chapter 3 of the INP. The results of long-term unattended noise monitoring are provided in Table 1.

The adopted evening and night RBLs did not include any project noise contributions as evening and night campaigning was not undertaken during the survey period. The noise monitoring charts for the background logging assessment are provided in Appendix B.

Table 1 Background Noise Monitoring Summary

Monitoring Location	Period[1]	Measured Background Noise Level (L_{A90}), RBL, dBA	Measured LAeq, dBA
L1 (Greenie Drive)	Day	33	59
	Evening	30 (28)[2]	53
	Night	30 (23)[2]	51

Note: Excludes periods of wind or rain affected data. Meteorological data obtained from the Bureau of Meteorology Ballina Airport AWS (28.8353 S, 153.5585 E, 1m AMSL).

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Note 2: Minimum RBL of 30dBA adopted as per the INP. Bracketed value measured RBL.

3.2 Attended Noise Monitoring

To verify non-project contributions during the unattended noise measurements, attended noise measurements were conducted at each receptor location when the plant was not operational. Measurements were carried out using Svantek Type 1, 971 noise analyser on Thursday 3 August 2017 and Wednesday 16 August 2017. The monitoring consisted of 15-minute monitoring intervals, one 15-minute measurement completed at each monitoring location for the day (7am-6pm) and night (10pm-7am) periods. The results of the attended noise measurements are presented in Table 2 to Table 5.

Table 2 Operator-Attended Background Noise Survey Results – R1 (Calypso Court)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
03/08/17 15:23 (Day)	66	43	34	Dir: E Wind Sp: 1.9m/s Rain: Nil	Domestic Noise 34 – 38 Birds 40 – 66 Cow 38 – 42 Aircraft Noise 40 – 45 Traffic Noise 36 – 40
16/08/17 22:00 (Evening/Night)	43	35	34	Dir: SW Wind Sp: 2m/s Rain: Nil	Wind 32 – 43 Birds 35 – 37 Distant traffic 34 – 36

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Table 3 Operator-Attended Background Noise Survey Results – R2 (Greenie Drive)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
03/08/2017 15:46 (Day)	75	56	38	Dir: ENE Wind Sp: 2.4m/s Rain: Nil	Traffic 45 – 75 Residential Noise 50 – 52 Birds & insects 40 – 47 Aircraft Noise 40 – 47
16/08/2017 22:21 (Evening/Night)	76	50	32	Dir: W Wind Sp: 0.2m/s Rain: Nil	Distant traffic 29 – 41 Birds 35 – 37 Local traffic 44 – 76 Livestock <38

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Table 4 Operator-Attended Background Noise Survey Results – R3 (1353 Teven Road)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
16/08/2017 16:55 Day	87	67	40	Dir: W Wind Sp: 2m/s Rain: Nil	Birds 38 – 42 Traffic 46 – 87 Wind in trees <46
16/08/2017 22:40 Night	81	56	41	Dir: W Wind Sp: 1m/s Rain: Nil	Insects <36 Local traffic 38 – 81 Dog bark 43

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Table 5 Operator-Attended Background Noise Survey Results – R4 (Alstonville Hockey Club)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
16/08/2017 17:17 Day	83	59	38	Dir: W Wind Sp: 2.2m/s Rain: Nil	Wind in trees 38 – 41 Birds 38 – 53 Aircraft 36 – 42 Pedestrians 41 – 53 Traffic 38 – 83
16/08/2017 22:58 Night	52	34	33	Dir: W Wind Sp: 1.2m/s Rain: Nil	Distant traffic 33 – 36 Machinery 33 – 34 Birds 35 – 38 Wind 33 – 38

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

4 Operational Noise Criteria

4.1 INP Criteria

4.1.1 Assessing Intrusiveness

The intrusiveness criterion essentially means that the equivalent continuous noise level (LAeq) from the project should not be more than 5dB above the existing rating background level (RBL) in any assessment period. The intrusive criteria established as per the INP are presented in Table 6.

Table 6 Noise Criteria Summary

Monitoring Location	Period[1]	Measured Background Noise Level (LA_{90}), RBL, dBA	LAeq 15min (RBL + 5dB)
L1 (Greenie Drive)	Day	33	38
	Evening	30 (28)[2]	35
	Night	30 (23)[2]	35

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Note 2: As per INP Evening & Night criteria cannot be set higher than Day RBL (bracket RBL's shown for reference).

4.1.2 Assessing Amenity

The amenity assessment is based on noise criteria relevant to a specific land use or locality. The criteria relate only to limiting cumulative or combined levels of industrial noise in a locality. Where existing industrial noise approaches the criterion value, then noise levels from proposed industries need meet the amenity criteria so that cumulative noise or 'industrial-creep' is minimised. The amenity assessment methodology takes into consideration areas of high traffic noise when assessing ambient industrial noise.

Private residences and other sensitive receivers potentially affected by the project are safeguarded by the EPA's suburban amenity category as per Table 2.1 of the INP. Table 2.1 of the INP for receivers is reproduced in Table 7.

Table 7 Amenity Criteria

Type	Period[1]	Recommended LAeq Noise Level dBA		Amenity Criteria, LAeq(period)
		Acceptable	Recommended Maximum	
Suburban Residential	Day	55	60	55
	Evening	45	50	45
	Night	40	45	40

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

4.1.3 Project Specific Noise Levels

The operational noise emission criteria for the project have been set in accordance with Section 3.0 of the INP. The intrusiveness and amenity criteria have been set, based on unattended logging measurements. The Project Specific Noise Levels (PSNLs) (project criteria) are the lower of the intrusive or amenity criteria. However, in accordance with the INPs application notes, where the amenity criterion is marginally lower than the intrusive criteria, both may be applied.

This is due to the amenity being assessed over several hours while the intrusive is assessed over a fifteen-minute period. The PSNLs for the site are presented in Table 8.

Table 8 Project Specific Noise Levels

Receiver Location	Period[1]	RBL	Intrusiveness Criteria LAeq(15min), dBA	Amenity Criterion LAeq(period), dBA	PSNL dBA
L1	Day	33	38	55	38
	Evening	30[2]	35	45	35
	Night	30[2]	35	40	35

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Note 2: As per INP the minimum RBL of 30dBA has been adopted for noise levels background noise levels below 30dBA.

5 Operational Noise and Compliance Assessment

5.1 Operational Noise Results

To quantify the noise emissions from the Boral plant, attended measurements were conducted when the plant was operational on 3 August 2017 at the four selected monitoring locations. Where possible throughout each survey, the operator quantified the contribution of any significant noise sources. The results of the measurements are presented in Table 9 to Table 12.

Table 9 Operator-Attended Noise Emissions Survey Results – R1 (Calypso Court)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
03/08/17 16:34 (Day)	63	39	34	Dir: NE Wind Sp: 1.9m/s Rain: Nil	Plant Hum 30 – 33 Birds 40 – 63 Domestic Noise 38 – 41 Traffic Noise 38- 41 Dogs Barking 40 – 46
Boral Site LAeq(15-min) Contribution					31
03/08/17 22:00 (Evening/Night)	58	42	37	Dir: N Wind Sp: 3.5m/s Rain: Nil	Plant Hum 34 – 38 Insects 39 – 43 Aircraft 41 – 58
Boral Site LAeq(15-min) Contribution					36

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Table 10 Operator-Attended Noise Emissions Survey Results – R2 (Greenie Drive)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
03/08/2017 16:56 (Day)	74	37	40	Dir: NNE Wind Sp: 1.6m/s Rain: Nil	Passing Traffic 42 – 74 Cows 59 – 65 Plant Hum 25 – 28 Birds and Insects 34 – 38
Boral Site LAeq(15-min) Contribution					<30
03/08/17 22:20 (Evening/Night)	78	50	35	Dir: N Wind Sp: 3m/s Rain: Nil	Traffic 43 – 78 Insects 38 – 42 Plant Hum 32 – 35
Boral Site LAeq(15-min) Contribution					34

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Table 11 Operator-Attended Noise Emissions Survey Results – R3 (1353 Teven Road)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
03/08/17 17:15 Day	88	69	39	Dir: N Wind Sp: 0.1m/s Rain: Nil	Traffic Passing 60 – 88 Bird and Insects 38 – 44
Boral Site LAeq(15-min) Contribution					Boral Inaudible
03/08/17 22:38 Night	88	61	39	Dir: N Wind Sp: 3.5 m/s Rain: Nil	Traffic Hum 47 – 88 Leaves Rustling 43 – 44 Insects 40 – 42 Plant hum 25
Boral Site LAeq(15-min) Contribution					<30

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

Table 12 Operator-Attended Noise Emissions Survey Results – R4 (Alstonville Hockey Club)

Date - Time (hrs)	Primary Noise Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
	LAmax	LAeq	LA90		
03/08/17 17:36 Day	69	48	33	Dir: N Wind Sp: 0.1m/s Rain: Nil	Insects 36 – 38 Traffic 35 – 69 Background Burner Hum <30
Boral Site LAeq(15-min) Contribution					27
16/08/2017 22:56 Night	75	42	33	Dir: N Wind Sp: 4.1 m/s Rain: Nil	Insects 33 – 38 Traffic 60 – 75 Plant Hum 25 – <30
Boral Site LAeq(15-min) Contribution					<30

Note 1: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

5.2 Low Frequency and Tonal Noise Assessment

Noise emissions from the project site were audible at receivers R1 and R2 during the evening/night period attended measurements, and included low frequency noise levels at location R1.

Due to the position and lower elevation of the plant compared to the surrounding topography, it is anticipated the tonal source was associated primarily with the plant's exhaust stack. Further analysis of the octave measured data was completed to determine if modifying factors as per Section 4 of the INP are applicable to the project.

Analysis of site only noise levels identified that a +5dB modifying factor is applicable at R1 due to tonal and low frequency (C-A) noise components. It is noted that as per the INP where both tonal and low frequency components are present, only one 5dB correction is applicable.

Analysis of the measurement at R2 demonstrated that modifying factors were not applicable for this catchment.

5.3 Compliance Assessment Results

Table 13 presents the measured Boral contribution to the ambient environment at each monitoring location assessed against the day, evening and night PSNL derived from the INP assessment methodology.

Table 13 Industrial Noise Policy Compliance Assessment

Receiver	Operational Noise Level Contribution LAeq(15min) dBA		PSNL LAeq(15min) dBA			Compliant		
	Day	Evening/Night[2]	Day	Evening	Night	Day	Evening	Night
R1 (Calypso Court)[1]	31	41	38	35	35	✓	X	X
R2 (Greenie Drive)	<30	34	38	35	35	✓	✓	✓
R3 (Teven Road)	Nil	<30	38	35	35	✓	✓	✓
R4 (Hockey Club)	<30	<30	38	35	35	✓	✓	✓

Note 1: Includes 5dB modifying factor for low frequency as per the INP.

Note 2: Evening and night assessed against same criteria.

Noise from the project was above the relevant PSNL by 1dBA at R1. Taking into account the modification factors as per Section 4 of the INP, this equates to a 6dB contribution above the evening/night PSNL. Remaining measurements demonstrated compliance with relevant PSNLs for all assessed locations during day, evening/night periods.

It is noted that the noise contribution at R1 was obtained during the presence of a north east wind and should be considered a worst case scenario. Furthermore, the plant does not undertake regular night time operations, typically night operations are limited to several occasions per year pending market demands.

6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Boral (NSW) Pty Limited for Alstonville Asphalt Plant, Alstonville, NSW. The assessment was completed to quantify site noise emissions and to determine compliance against relative criteria derived in accordance with the INP.

Attended monitoring has identified that operational emissions generated by the plant were 1dBA above relevant criteria at R1 during the evening and night-time period. Additionally, further analysis identified a 5dB modifying factor was applicable. Overall results identified that the project contribution was 6dB above the PSNL for R1 during the evening and night period.

Furthermore, the elevated levels were measured during a north-east wind directing plant emissions to R1. Northerly winds would be considered to be worst case meteorology conditions with respect to enhancing site emissions at R1.

The noise emissions from the project satisfied the daytime criteria at R1 and relevant criteria at R2, R3 and R4 for all assessment periods.

Appendix A – Glossary of Terms

Table A1 provides a number of technical terms have been used in this report.

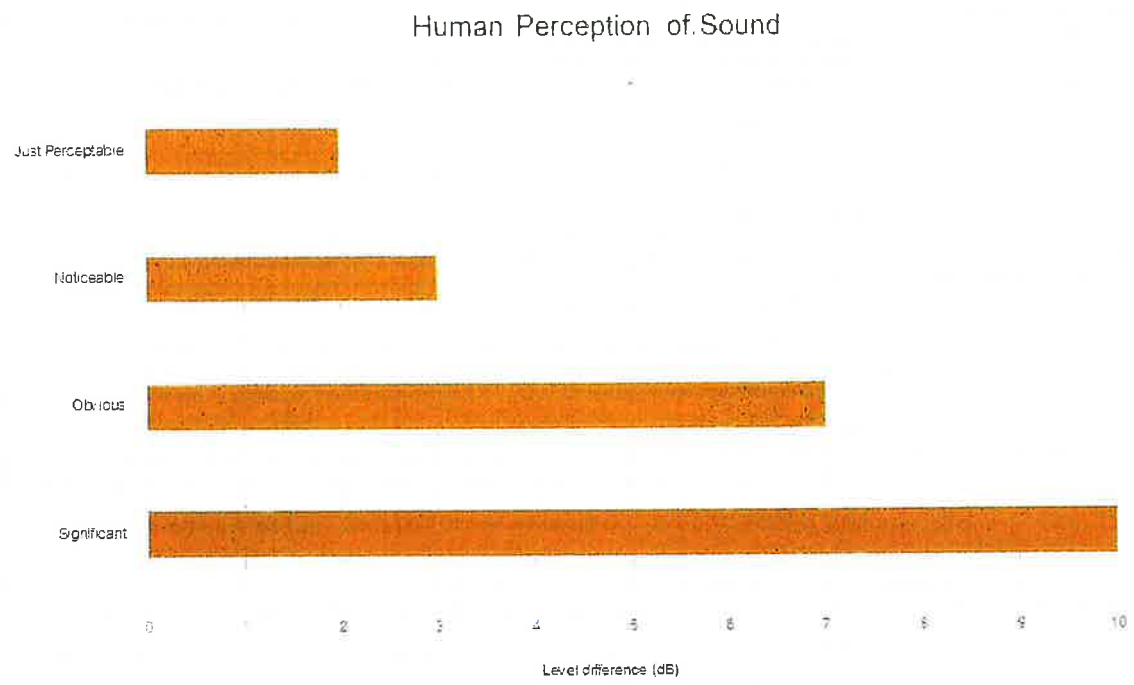
Table 1A Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

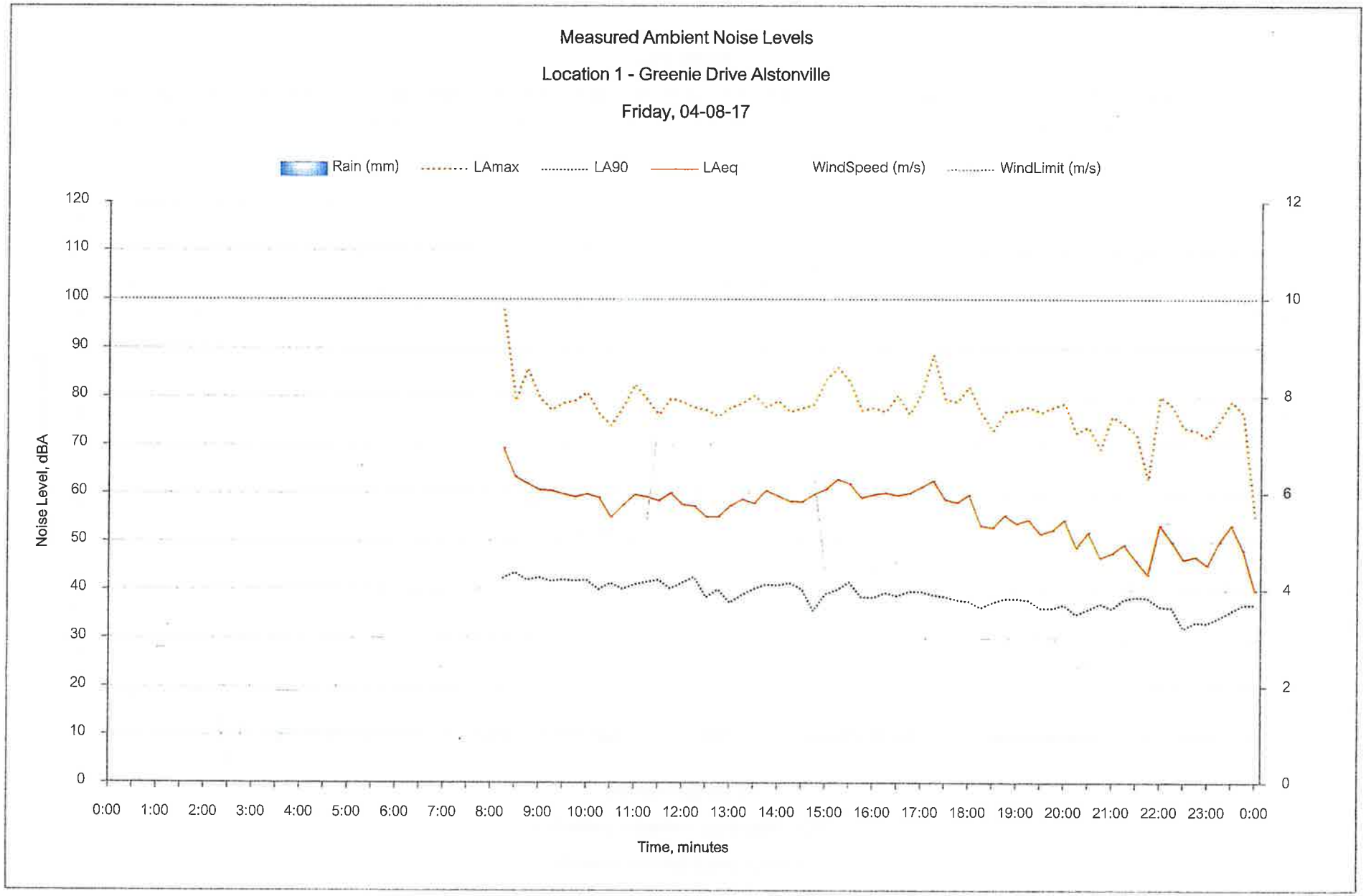
Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Appendix B – Logging Charts


Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Friday, 04-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
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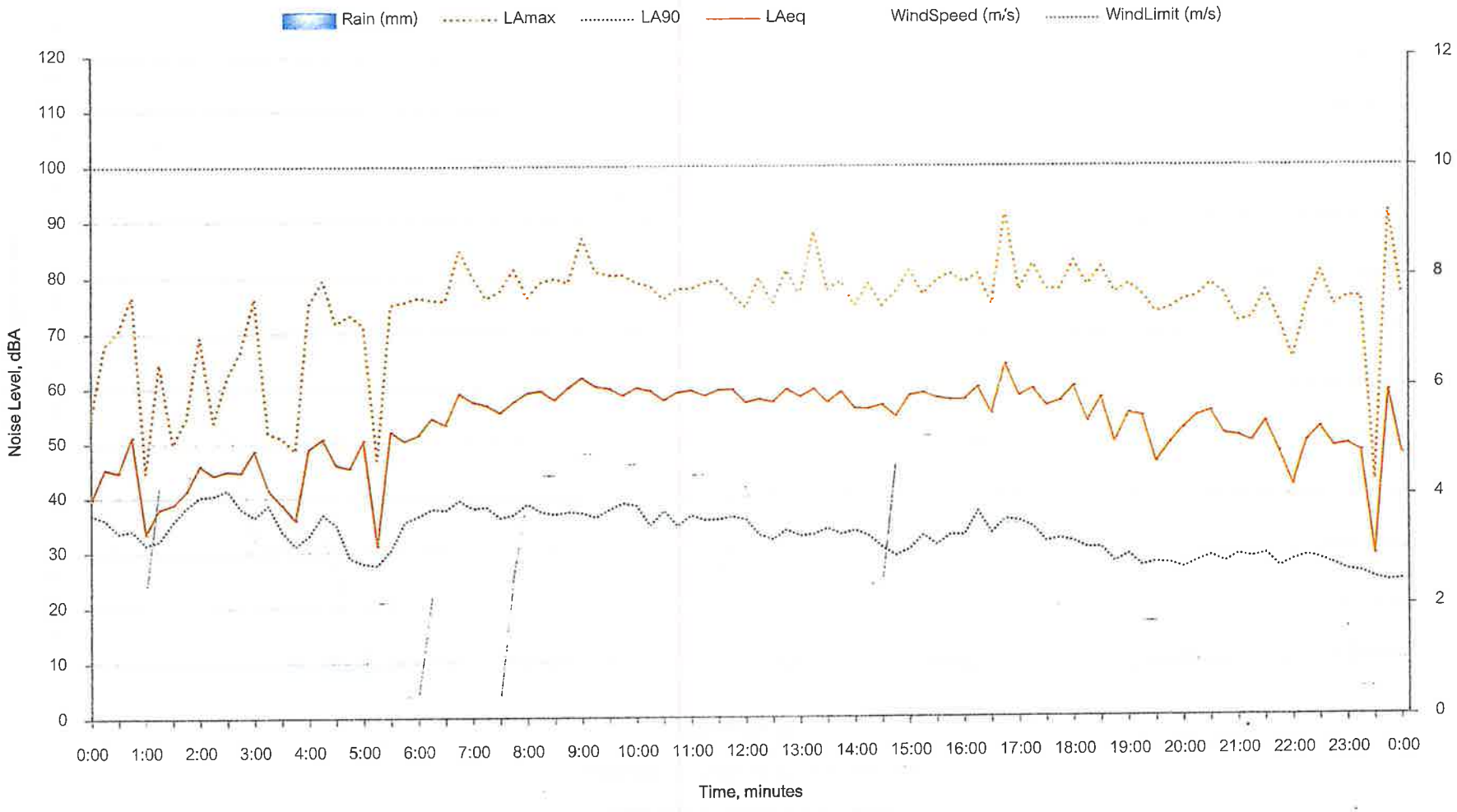
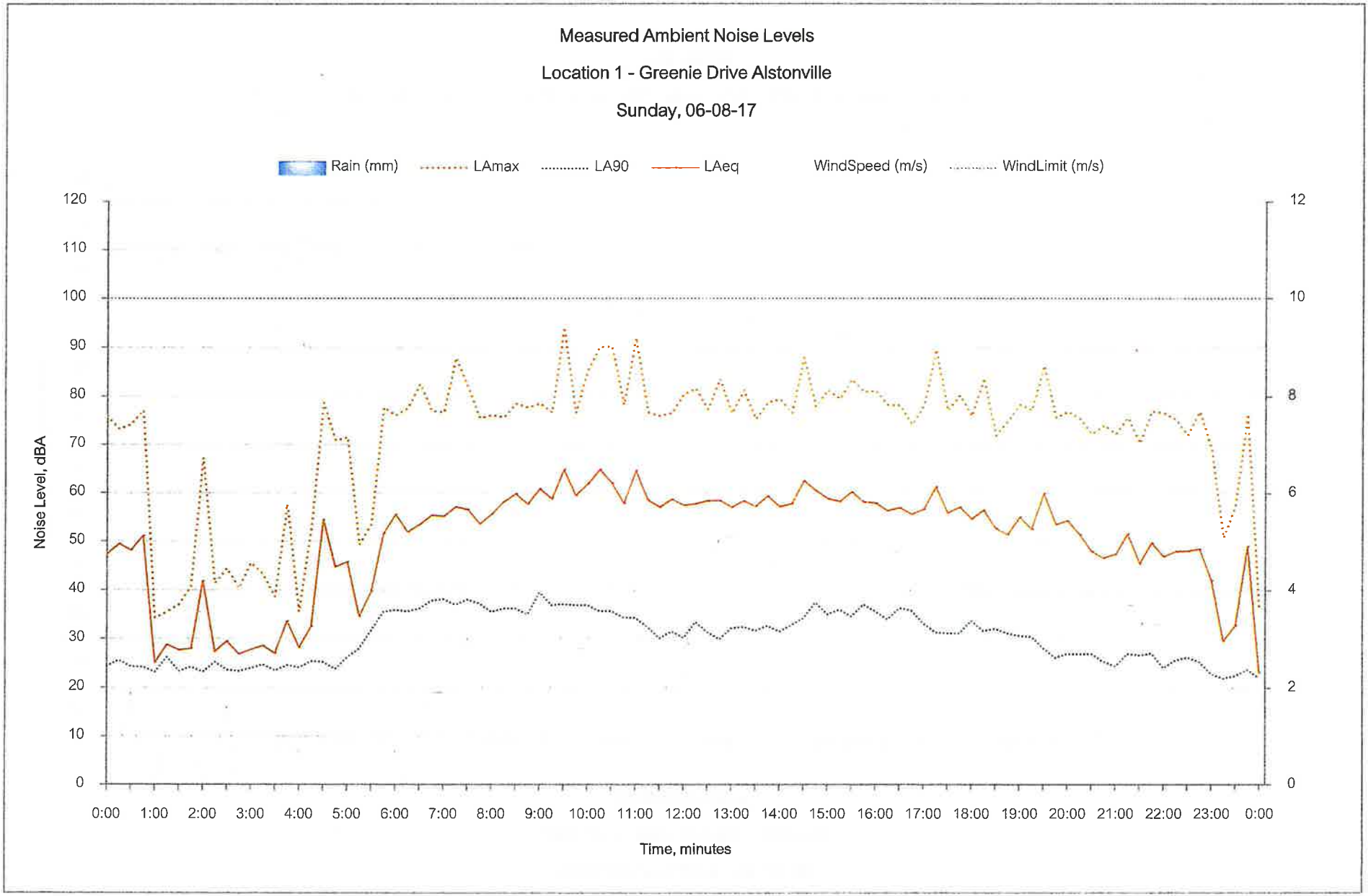
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time, minutes

Measured Ambient Noise Levels

Location 1 - Greenie Drive Alstonville

Saturday, 05-08-17




Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Sunday, 06-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
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3:00
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8:00
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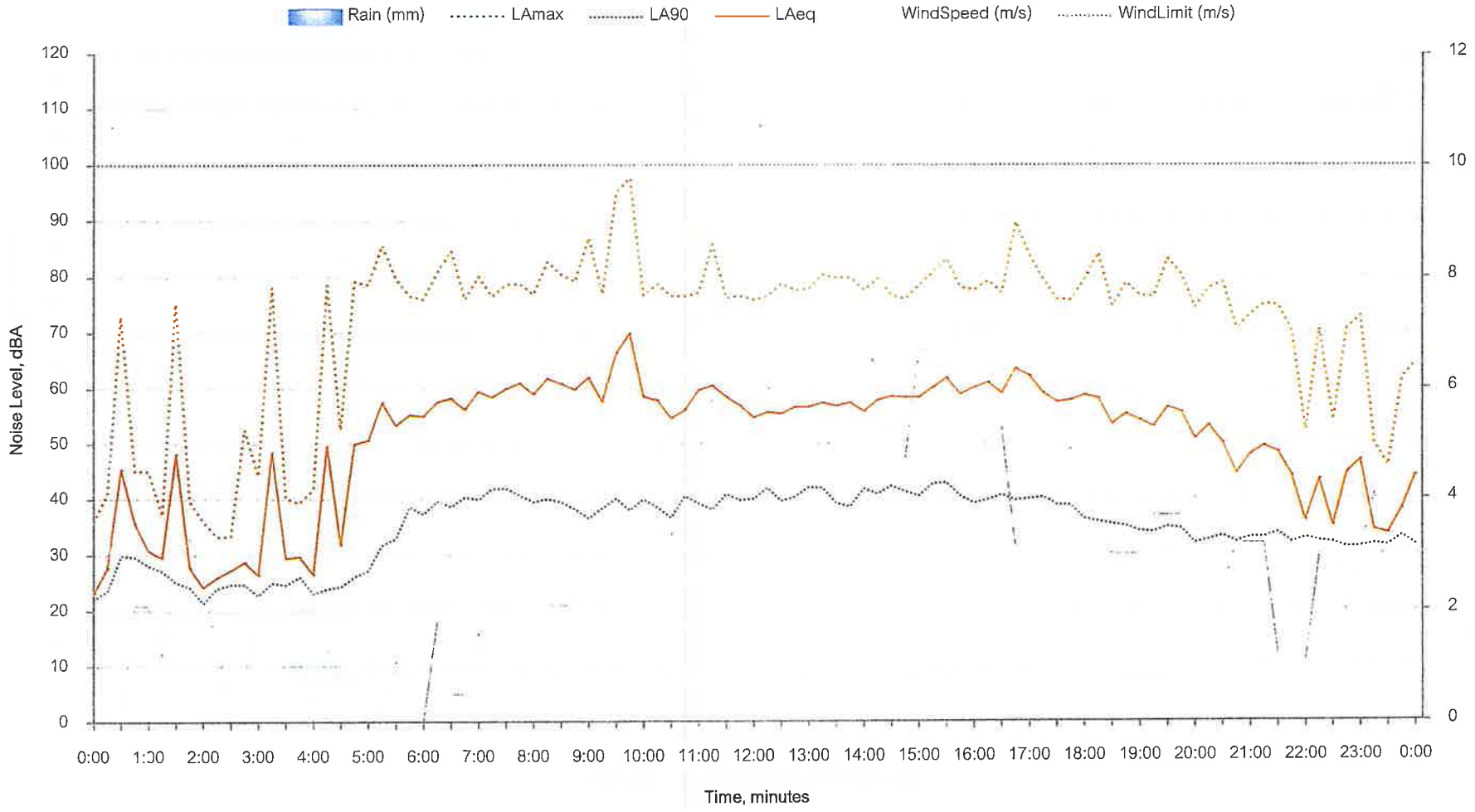
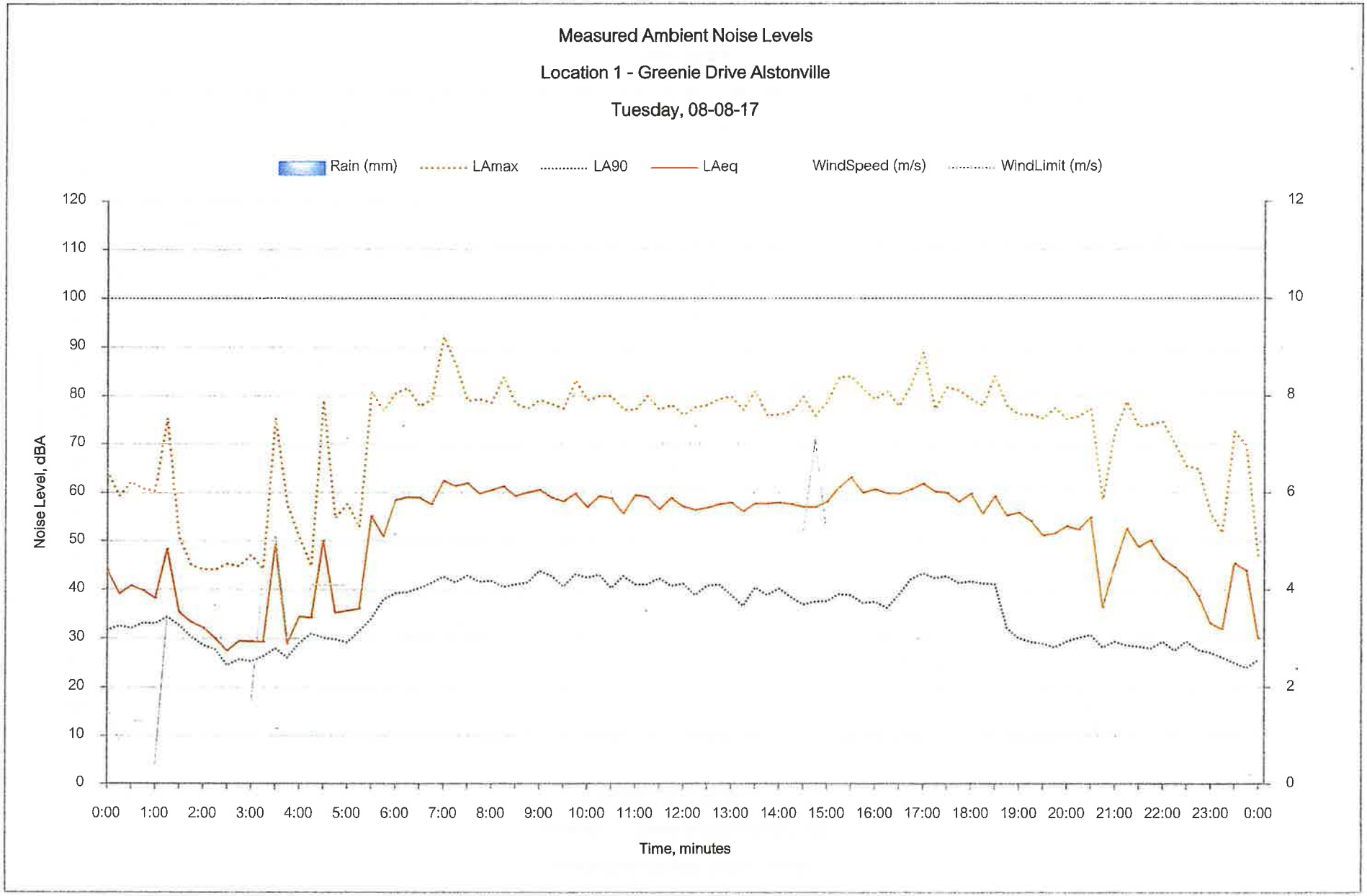
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time, minutes

Measured Ambient Noise Levels

Location 1 - Greenie Drive Alstonville

Monday, 07-08-17




Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Tuesday, 08-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
2:00
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9:00
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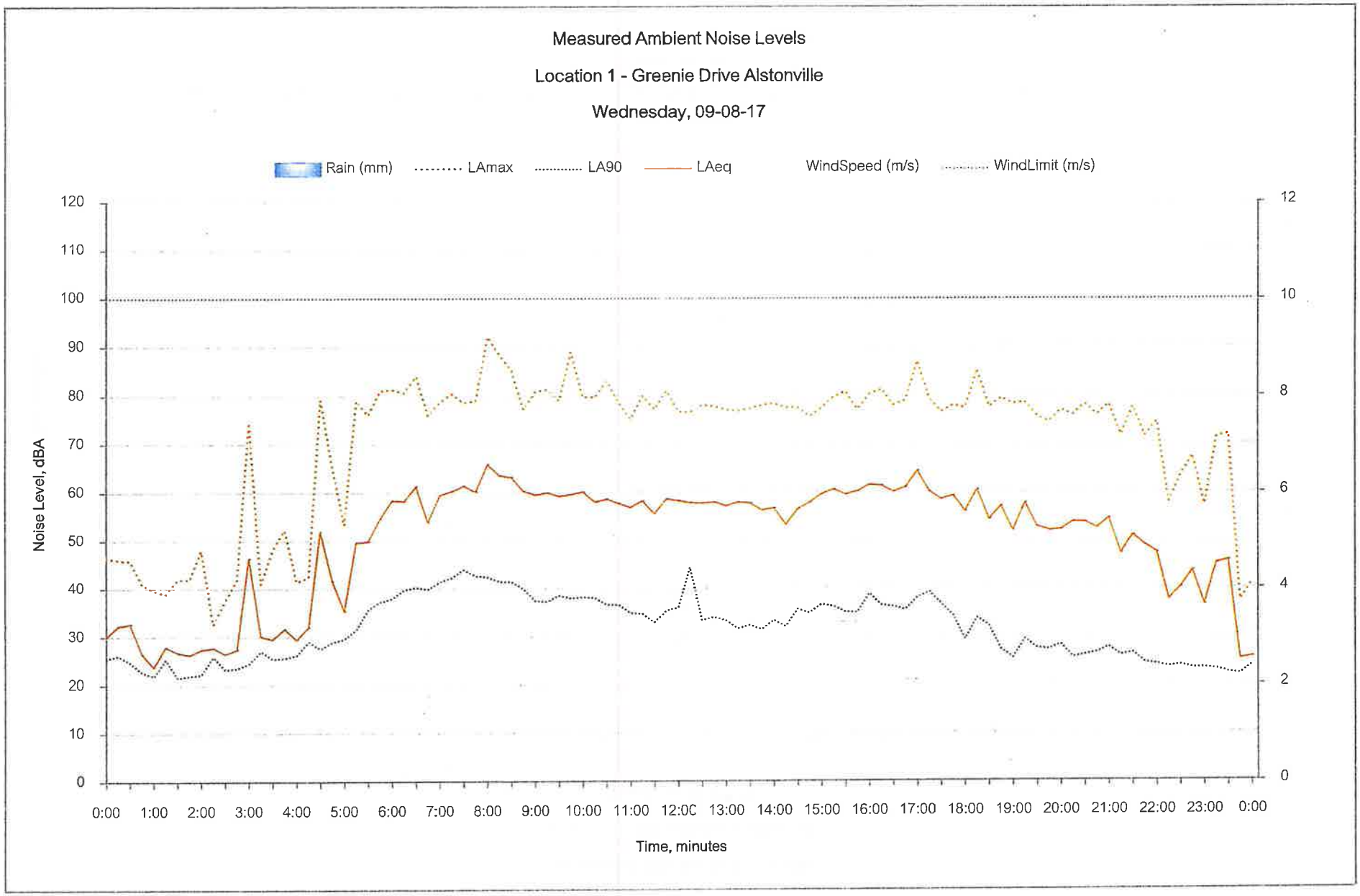
20:00
21:00
22:00
23:00
0:00
Time, minutes


Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Wednesday, 09-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
2:00
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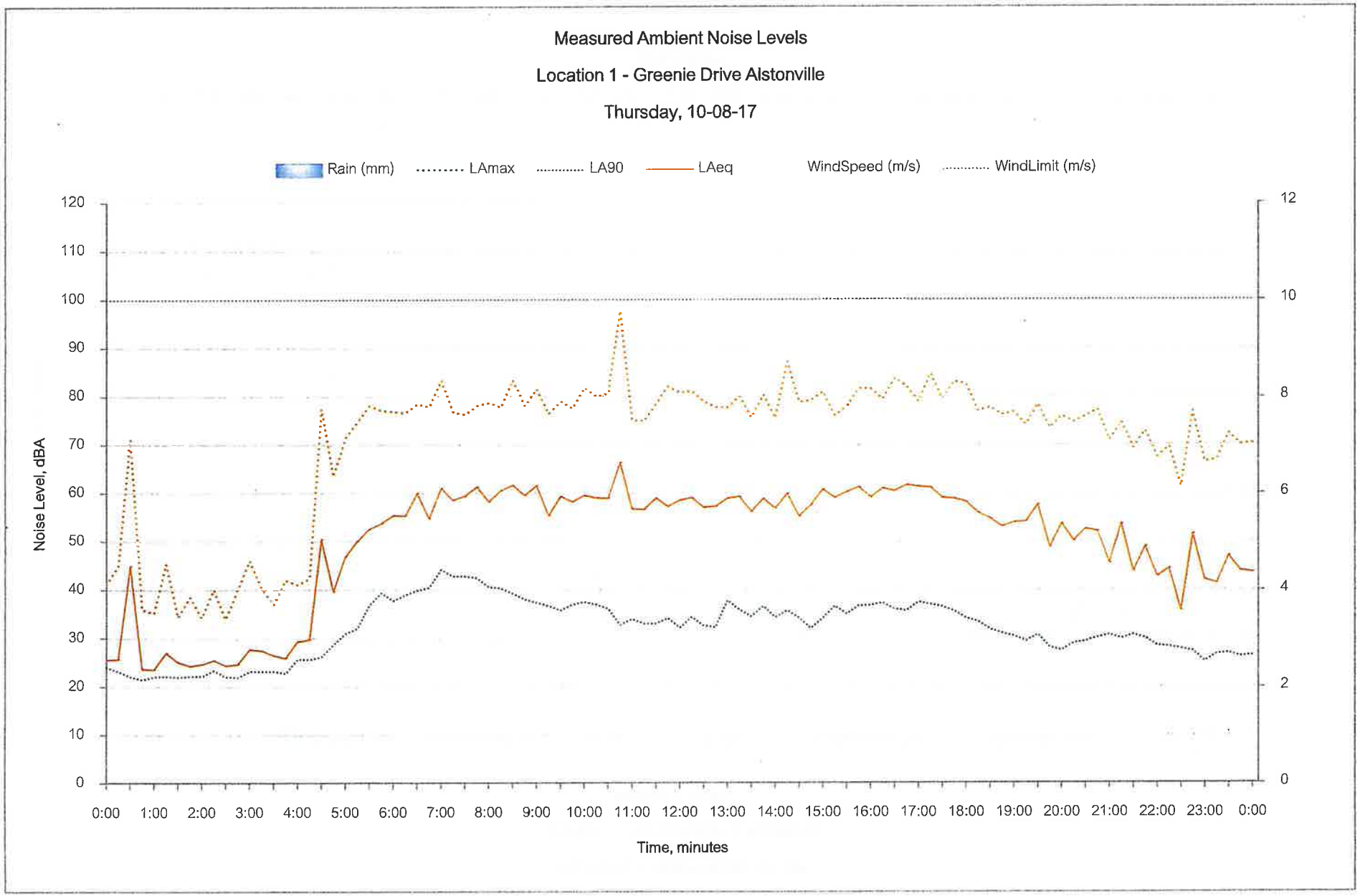
21:00
22:00
23:00
0:00
Time, minutes


Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Thursday, 10-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
2:00
3:00
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7:00
8:00
9:00
10:00
11:00
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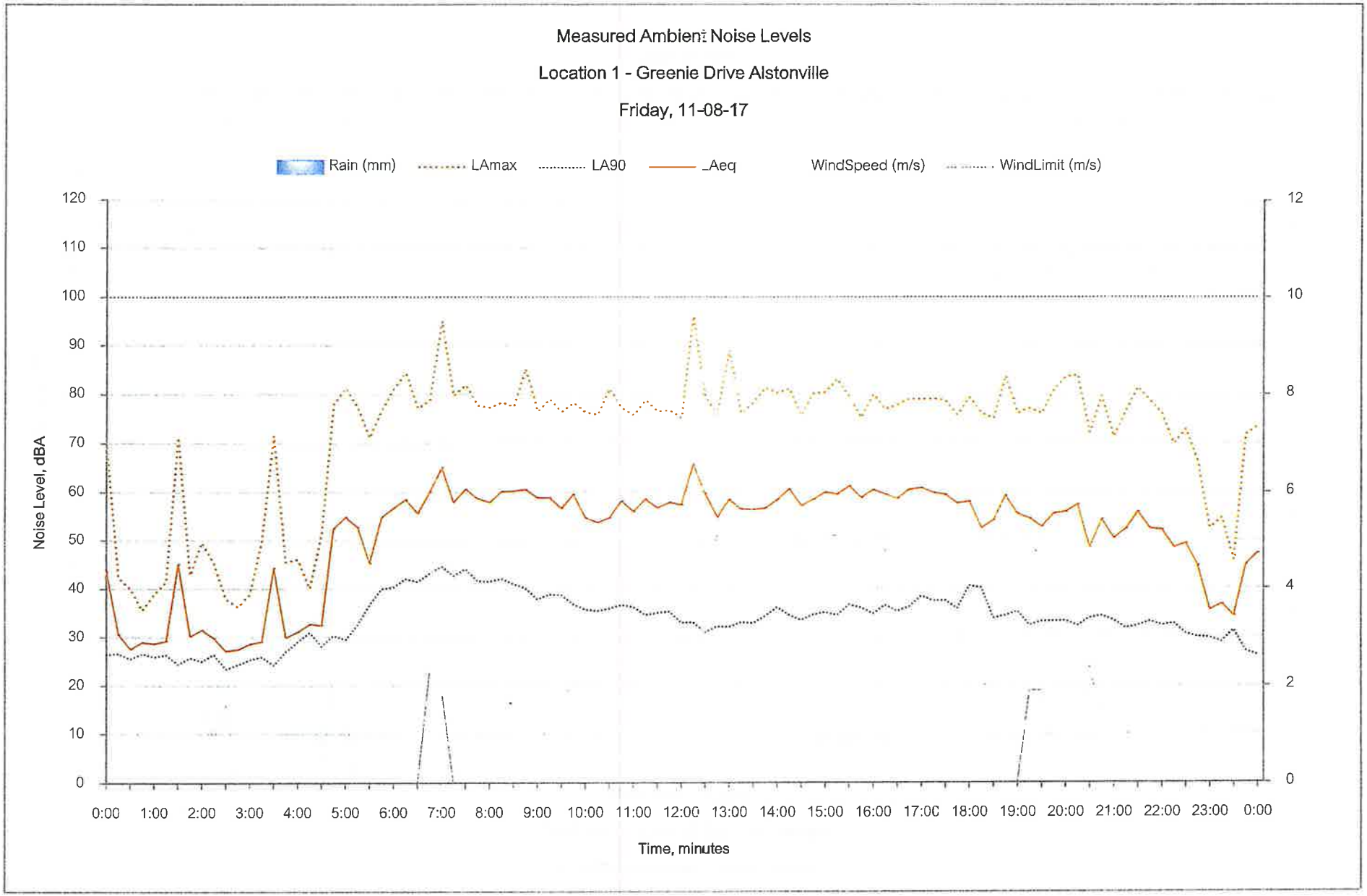
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time, minutes


Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Friday, 11-08-17
Rain (mm)
LAmax
LA90
_Aeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
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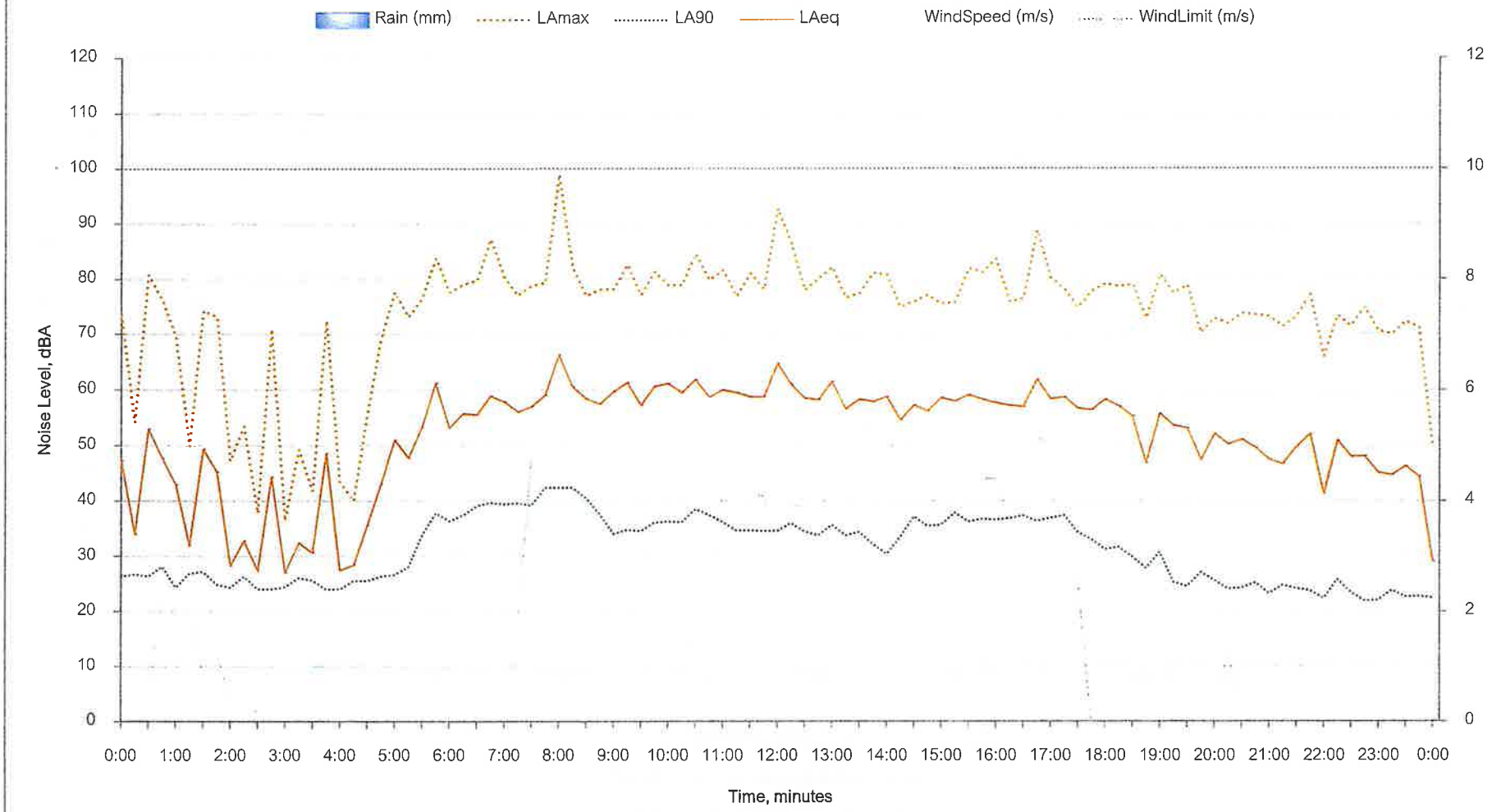
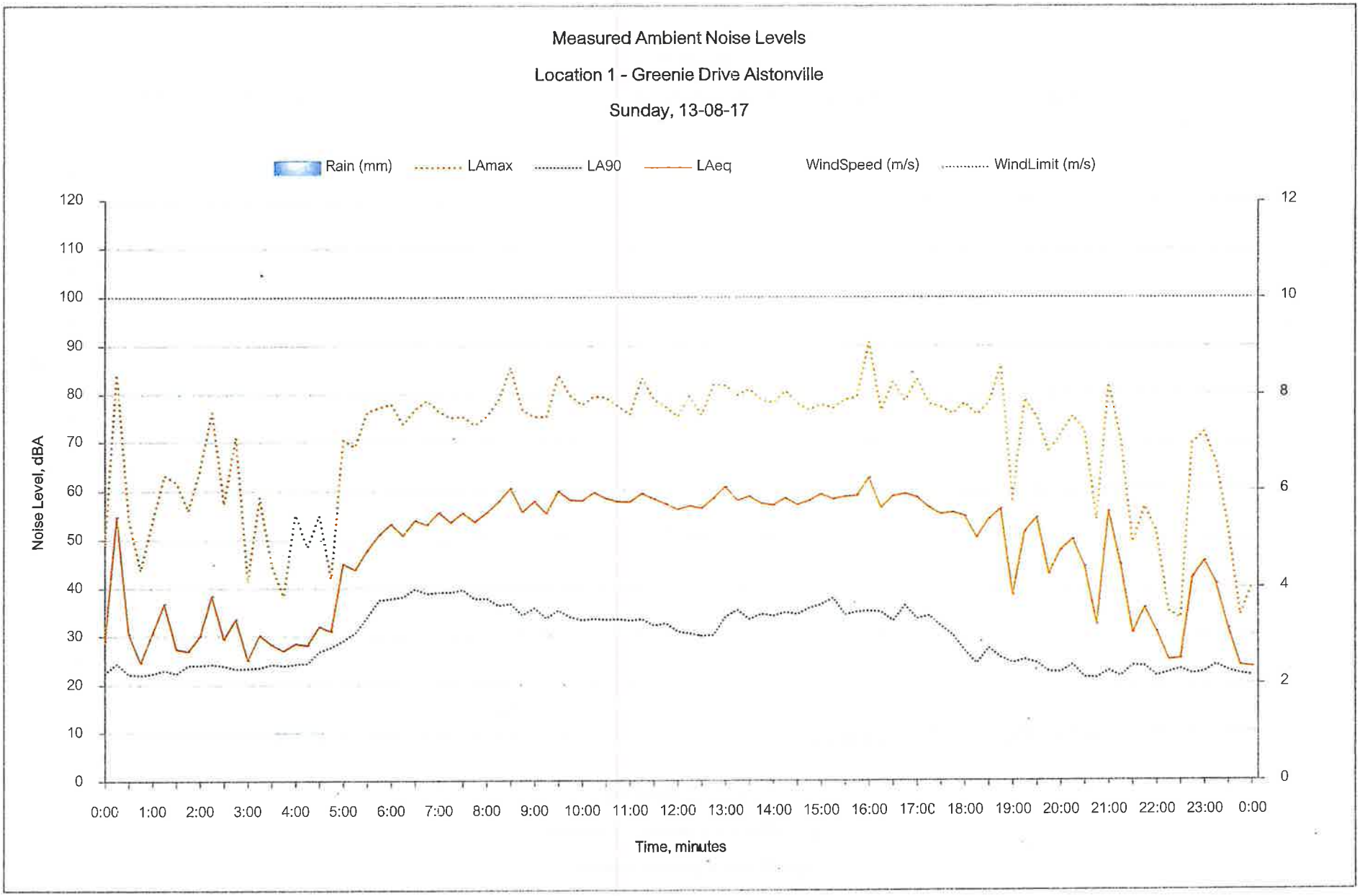
23:00
0:00
Time, minutes

Measured Ambient Noise Levels

Location 1 - Greenie Drive Alstonville

Saturday, 12-08-17




Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Sunday, 13-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
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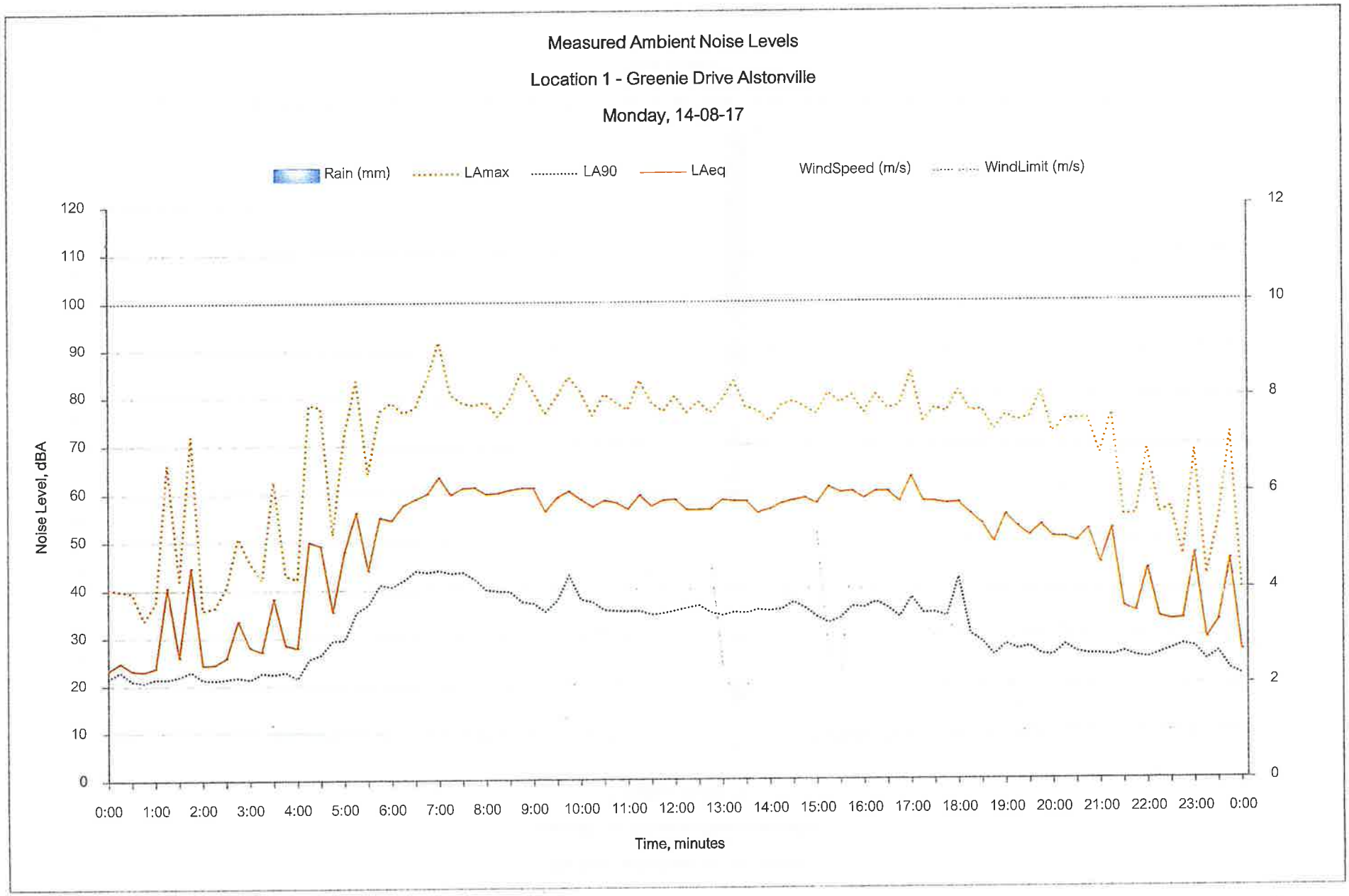
0:00
Time, minutes


Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Monday, 14-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
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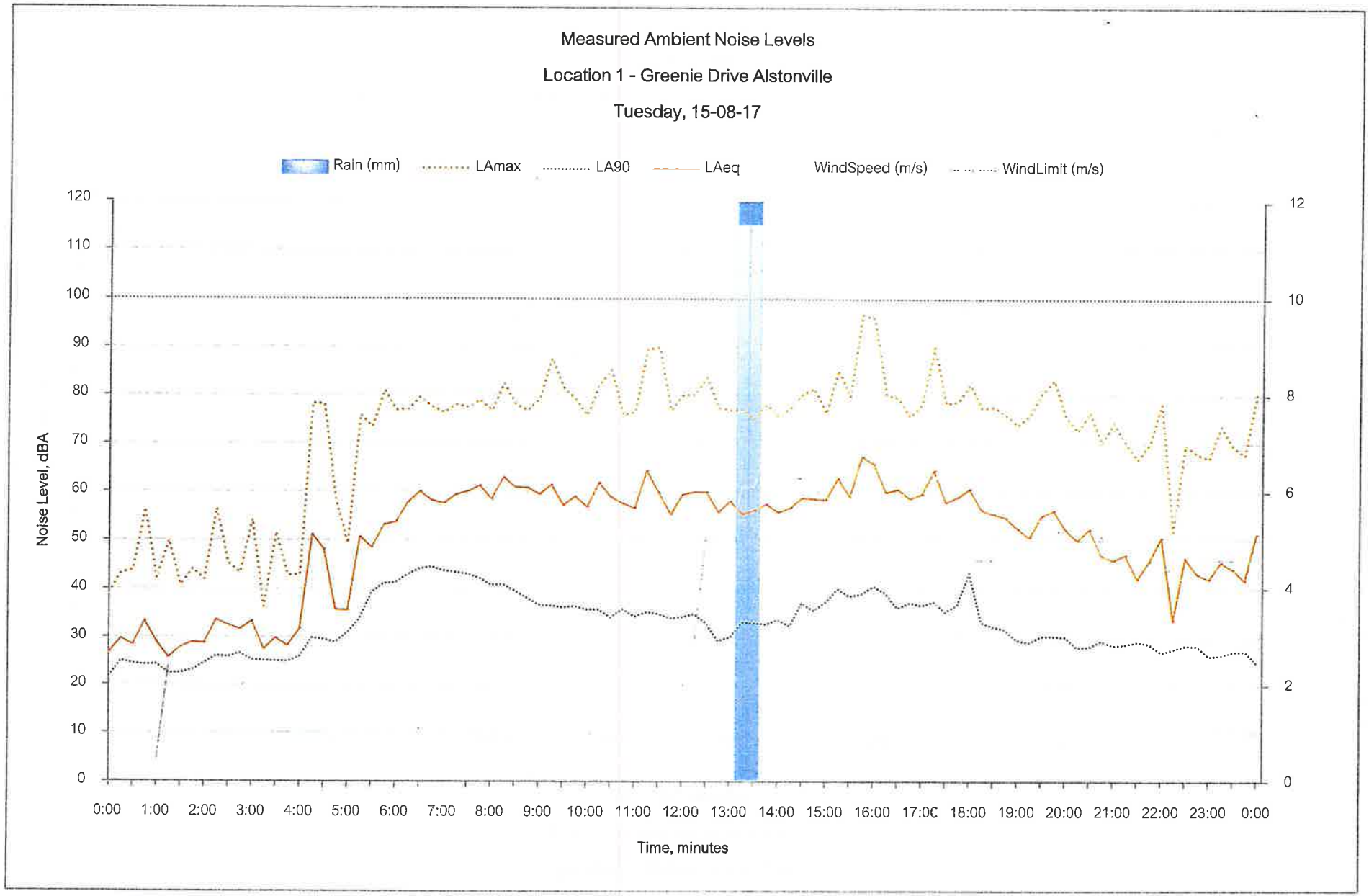
20:00
21:00
22:00
23:00
0:00
Time, minutes


Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Tuesday, 15-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
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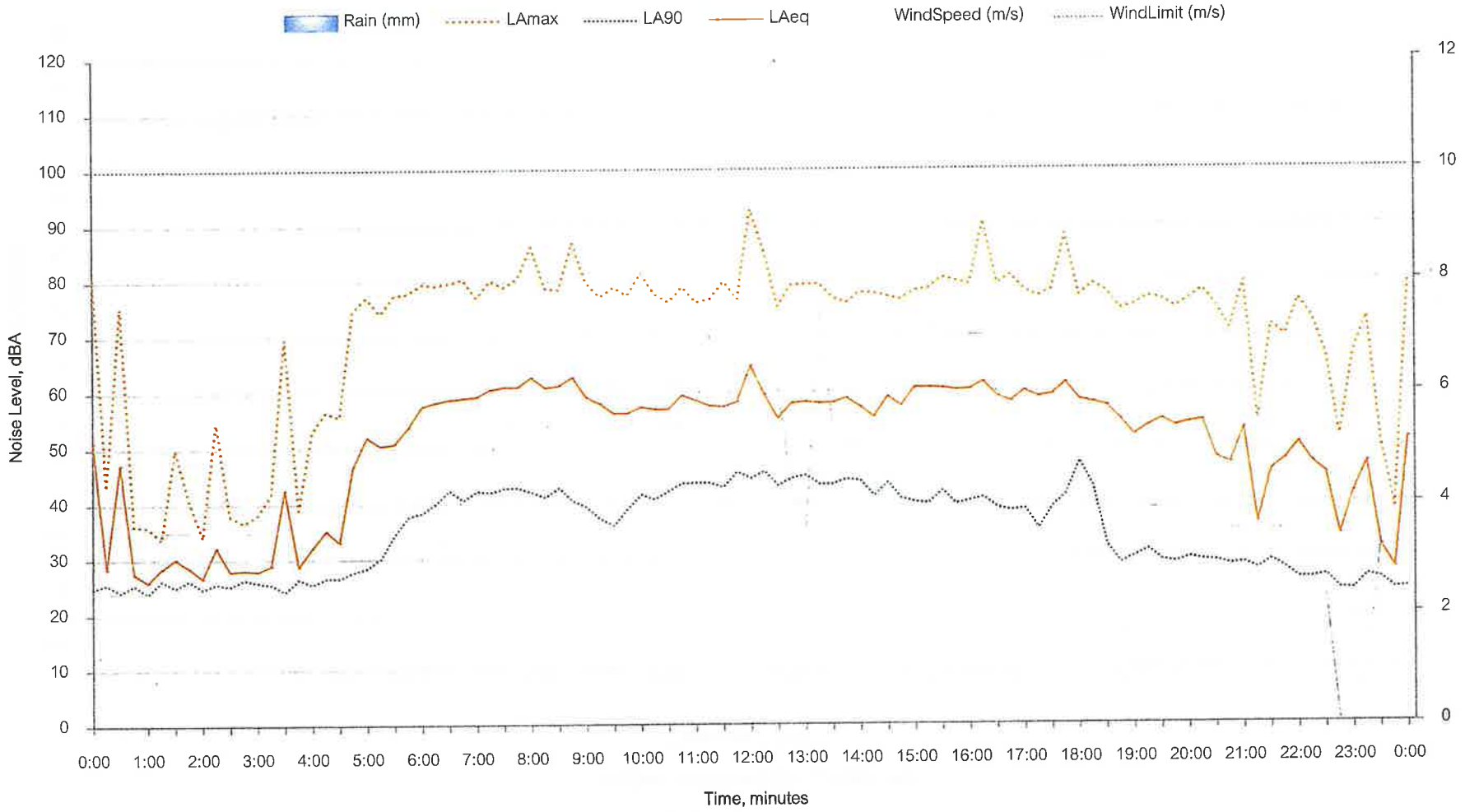
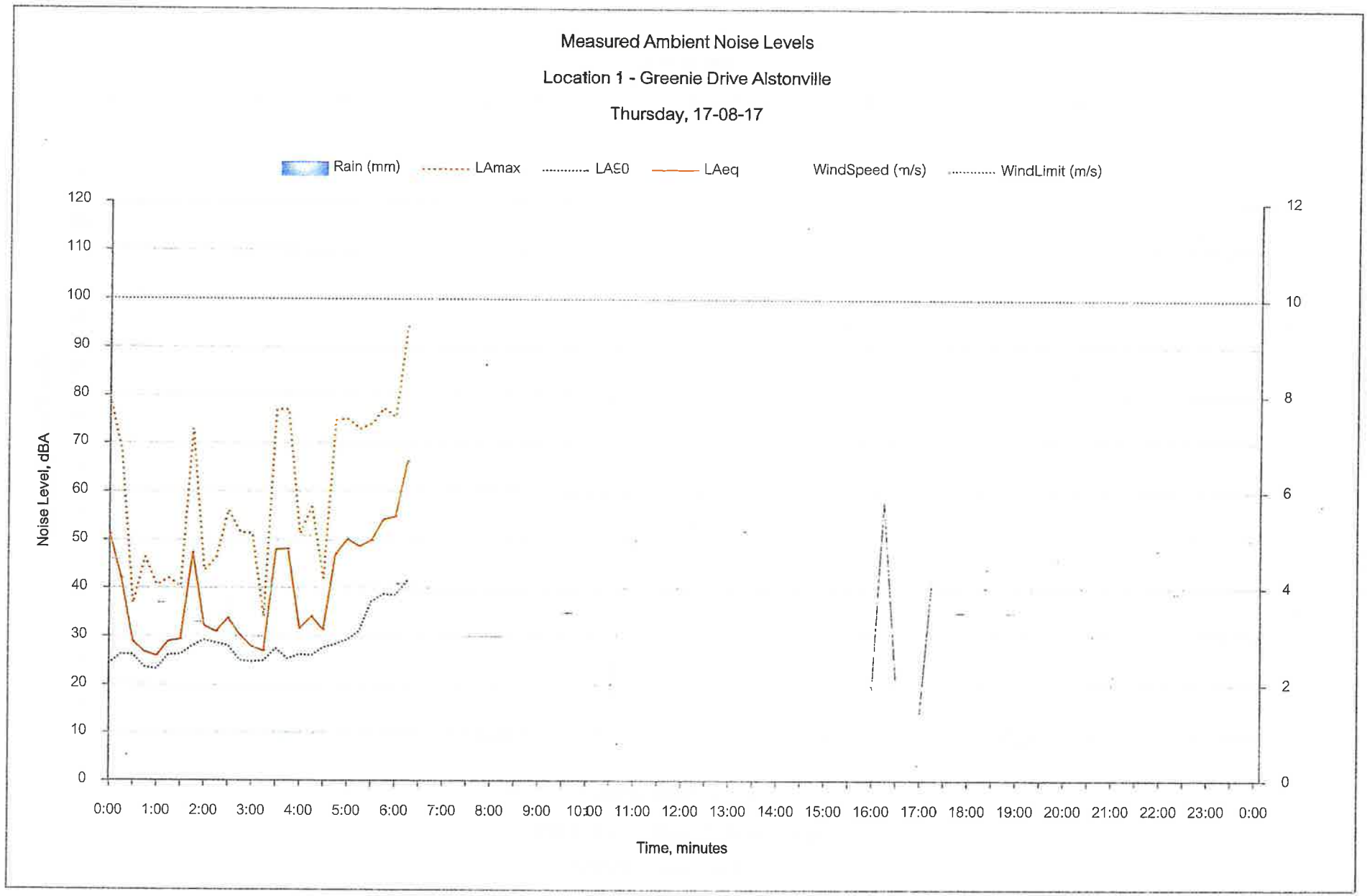
0:00
Time, minutes

Measured Ambient Noise Levels

Location 1 - Greenie Drive Alstonville

Wednesday, 16-08-17




Measured Ambient Noise Levels
Location 1 - Greenie Drive Alstonville
Thursday, 17-08-17
Rain (mm)
LAmax
LA90
LAeq
WindSpeed (m/s)
WindLimit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
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0:00
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22:00
23:00
0:00
Time, minutes

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www.mulleracoustic.com

MAC
Muller Acoustic Consulting

Attachment C **Road Traffic Noise Assessment (ENM)**

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26 October 2016

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Nathan Jeffery
HSE Advisor - NSW/ACT
Boral Construction Materials
Corner of Hi-Tech Drive and Craft Close
Toormina NSW 2452

Re: Road traffic noise assessment: Boral Alstonville

Dear Nathan,

1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Boral to conduct a road traffic noise assessment relevant to the asphalt plant located at 498 Gap Road, Alstonville to satisfy Condition 25 of DA 1995/127 (Amendment No. 4). The plant operates under Development Consent No. 1995/127 (as amended) issued by Ballina Shire Council (Ballina Council) on 30 March 1995. Boral lease the land on which the plant is located from Ballina Council. Condition 25 of Amendment No. 4 (Approved on 10 August 2016) states;

> Prior to the sourcing of aggregates and fines from proposed sources other than the adjoining Gap Road Quarry, a traffic noise assessment report prepared in accordance with the requirements of appendix B of the NSW Road Noise Policy must be submitted to and approved by council.

All relevant data and information utilised in this assessment has been referenced from the document *Traffic assessment – Modification to development consent* (EMM 2016).

2 Project description

The plant is located in the northern rivers region of NSW in Alstonville, approximately 7 km to the west of the Pacific Highway on Gap Road near its junction with Teven Road. Ballina is located approximately 10 km south-east of the plant. The plant supplies products to a large area of northern NSW including Lismore, Ballina, Bangalow, Byron Bay, and other various regional locations.

The plant entrance is located on Gap Road, about 250 m east of Teven Road. The plant is located within the southern part of Tuckombil Quarry. The road network utilised by trucks associated with the plant are primarily Gap Road and Teven Road. Gap Road is a minor rural road serving properties in areas east of Alstonville towards Ballina. Teven Road is a two lane rural road which connects the Pacific Highway, west of Ballina, to Alstonville via the locality of Teven. It has both urban and rural sections serving rural properties, including the access road to Boral's Teven Quarry, from where external aggregates and fines for the plant are likely to be sourced.

There are a number of residences located along the road transport route including on Teven Road, north of Gap Road. These residences have the potential to be impacted by an increase in road traffic noise resulting from the proposed increase in transport volumes associated with the importation of aggregates and fines for the asphalt plant. The proposed increase in site related traffic would generate an additional 20 truck movements daily on Teven Road

Vehicular traffic movements (associated with Boral's Alstonville asphalt plant) normally occur during the general work hours, which are 6 am to 6 pm Monday to Saturday. However, asphalt production for

emergency work is permitted on Sundays and public holidays and 24 hour operations are also permitted to supply night time road work up to 60 days per year, up to a maximum of four consecutive days.

3 Criteria

The road traffic noise assessment has been conducted in accordance with the NSW EPA *Road Noise Policy* (RNP) (EPA 2011). The RNP identifies several noise assessment criteria according to road categories and land uses. The RNP road categories from Table 2 are reproduced in Table 1 below.

Table 1 Road Categories and management responsibility

Road category	Functional role	Examples	Management responsibility
Freeways or motorways/ arterial roads	Support major regional and inter-regional traffic movement Freeways and motorways usually feature strict access controls via grade separated interchanges	Pacific Highway, Taree M4 Motorway, Eastern Creek Princes Highway, Arncliffe	State government
Sub-arterial roads[1]	Provide connection between arterial roads and local roads May support arterial roads during peak periods May have been designed as a local street but can serve major traffic-generating developments or support non-local traffic.	Bourke Street, Surry Hills Cook Street Baulkham Hills Forest Road, Lugarno	Local councils
Local roads	Provide vehicular access to abutting property and surrounding streets Provide a network for the movement of pedestrians and cyclists and enable social interaction in a neighbourhood. Should connect, where practicable, only to sub-arterial roads.	Prince Street, Randwick Pell Street, Howlong Killarney Drive, Killarney Heights	Local councils

Notes: 1.Previously designated as 'collector roads' in Environmental criteria for road traffic noise (Environment protection authority 1999)

Gap Road does not have residences located along the proposed transport route. Thus, Gap road has not been assessed further. Teven Road connects the Pacific Highway, an arterial road, and Bruxner Highway (via Ballina Road) and nearby local roads. It also supports major traffic generating developments and non-local traffic. The "sub-arterial" road type was adopted for the purpose of assessing road traffic noise at residential land uses on Teven Road since it fits the RNP description as described in Table 1 above.

The road traffic noise assessment criteria from Table 3 of the RNP (EPA 2011) relevant to residential land uses are reproduced in Table 2.

Table 2 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Assessment criteria, dB	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{Aeq(15\text{-}hr)}$ 60 (external)	$L_{Aeq(9\text{-}hr)}$ 55 (external)

Additionally, the RNP states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2 dB, after consideration of all feasible and reasonable noise mitigation or management measures.

In addition to meeting the assessment criteria, any significant increase in total traffic noise at residences must be considered. Residences experiencing increases in total traffic noise levels above those presented in

Table 3 should be considered for mitigation. It should be noted that the relative increase criterion does not apply to local roads, as per Section 2.4 of the RNP (EPA 2011).

Table 3 Relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase, dB	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{Aeq(15\text{-}hr)}$+12 dB (external)	Existing traffic $L_{Aeq(9\text{-}hr)}$+ 12 dB (external)

4 Assessment

The main transport route used by road trucks to travel between Boral's Teven quarry and the Alstonville asphalt plant is via Gap Road, Teven Road and North Teven Road. To quantify existing total traffic movements on the transport route, the daily traffic volumes have been determined from a seven day tube traffic count undertaken during the period of 14 to 21 December 2014. The count was undertaken approximately 100 metres to the north of the intersection at Gap and Teven Roads and is indicated on Figure 1. The existing average daily traffic movements (all traffic) are provided in Table 4.

Traffic route and noise monitoring location

Boral Asphalt Plant, Alstonville
Road traffic noise assessment
Figure 1

Table 4 Existing average daily traffic movements – December 2014

Road section	Existing average daily traffic movements (including Boral Alstonville)		
	Total – all vehicles	Heavy vehicles	% heavy vehicles
Teven Road - Northbound	780	55	7%
Teven Road - Southbound	775	51	7%

EMM completed seven days of unattended noise monitoring to establish existing road traffic noise levels on Teven Road. The logger was placed adjacent Teven Road, approximately 100m north of the intersection of Greenie Drive and Teven Road. The logger microphone was positioned approximately 15 metres from Teven Road. The road traffic noise monitoring location is indicated on Figure 1. The monitoring location was chosen after inspection of the site and giving due consideration to other noise sources which may influence the ambient noise environment and the safety of the logging device. The logger was used to validate road traffic calculations for existing and predictions of proposed traffic noise.

The unattended noise monitoring was carried out using an Acoustic Research Laboratories (ARL) EL316 noise logger (s/n 16-207-005). The noise logger was in place from 13 to 21 September, 2016. The noise logger was programmed to record statistical noise level indices continuously in 15 minute intervals. Calibration of the noise logger was checked prior to and following unattended noise monitoring. Drift in calibration did not exceed ±0.5 dB. The equipment carried appropriate and current NATA calibration certificates.

Weather data for the unattended noise monitoring period was obtained from Bureau of Meteorology's (BoM) Ballina Airport Automatic Weather Station (AWS ID 058198). The wind speed and the rainfall data was used to exclude noise data during periods of any rainfall and/or wind speed in excess of 5 m/s (approximately 9 knots) in accordance with methodology provided in the Industrial Noise Policy (INP) (EPA, 2000).

Unattended noise monitoring results from the logger is provided in Table 5.

Table 5 Unattended road traffic noise monitoring results

Location	Road section	Logging period	Assessment period[1]	Measured noise level, dB	RNP criteria, dB
Teven Road	Between Greenie Drive and Howards Road	13/9/16 to 21/9/16	Day	57 $L_{Aeq(15\text{-}hr)}$	60 $L_{Aeq(15\text{-}hr)}$
			Night	50 $L_{Aeq(9\text{-}hr)}$	55 $L_{Aeq(9\text{-}hr)}$

Notes: 1. According to the RNP the day period is from 7 am to 10 pm and the night period is from 10 pm to 7 am.

The Calculation of Road Traffic Noise (CORTN) (UK Department of Transport) method was used to calculate the total existing traffic noise emissions and predict future traffic noise emissions at the nearest privately owned residence that is setback approximately 20 metres from Teven Road (the transport route for the day and night assessment periods).

It was assumed that 90% and 10% of all existing traffic volume on the section of Teven Road north of Gap Road occur during RNP day and night periods, respectively. This is consistent with the traffic volume data recorded during the surveys on this section of Teven Road.

The results of the road traffic noise calculations for the nearest privately owned receivers on the transport route are presented in Table 6. It is noted that the attended and unattended monitoring data was used to validate the calculated existing traffic noise levels. The results show that the RNP noise criteria will be achieved in the future, inclusive of the proposed traffic movements.

Table 6 Road traffic noise levels

Road section/ RNP assessment period	Distance to nearest receiver (m)	Driving speed (km/h)	Calculated road traffic noise, $L_{Aeq,period}$, dB			Criteria	Difference between existing and future total traffic noise, dB
			Existing total traffic noise (including Boral Alstonville)	Project traffic noise	Future total traffic noise (Existing + Project)		
Teven Road / Day	20	60	57	44	57	60	+0.1
Teven Road / Night	20	60	50	37	50	55	+0.1

Notes: 1. Calculations assume 20 site generated truck movements daily between 6 am and 6 pm.

2. According to the RNP the day period is from 7 am to 10 pm and the night period is from 10 pm to 7 am.

For both the RNP day and night periods, the increase in road traffic noise level on Teven Road as a result of increased truck movements to/from the asphalt plant is predicted to be negligible (0.1 dB) at the nearest privately owned receivers.

The increase in road traffic noise level for the transport route also satisfies the RNP relative increase criterion of +12 dB.

5 Conclusion

EMM has completed a road traffic noise assessment to satisfy Condition 25 of DA 1995/127 (Amendment No. 4). Road traffic noise levels were assessed against the relevant assessment criteria from the RNP (EPA 2011) relevant to residential land uses.

It was found that predicted operational road traffic noise levels satisfy the relevant RNP noise requirements at all nearest assessment locations on the transport route.

We trust the above information meets your needs and if you have any further questions please contact our office.

Yours sincerely

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Attachment D **Odour Impact Assessment (Air Noise Environment)**

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AIR ENVIRONMENT CONSULTING

Report prepared for

Boral National

Alstonville Asphalt Plant

Odour Impact Assessment

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Glossary

Term	Definition
Units of measurement	
s	second
min	minute
h	hour
d	day
yr	year
kg	kilogram
t	tonne
t/d	tonnes per day
t/y	tonnes per year
m	metre
km	kilometre
m^2	square metres
m^3	cubic metres
m/s	metres per second
m^3/s	cubic metres per second
Atm	atmosphere (unit of air pressure)
°C	degrees Celsius
Other abbreviations	
BOM	Bureau of Meteorology
CALMET	Meteorological model used in conjunction with the CALPUFF dispersion model system
CALPUFF	California Puff Model - An advanced non-steady-state Lagrangian meteorological and dispersion modelling system
L_{mo}	Monin-Obukhov length
OER	Odour Emission Rate – total source rate of odour emission per second ($OU.m^3/s$ or OU/s)
SOER	Specific Odour Emission Rate – OER by unit area ($OU.m^3/m^2/s$ or $OU/m^2/s$)
EPA	NSW Environment Protection Authority
TAPM	The Air Pollution Model developed the Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Statistical terms	
IOA	Index of agreement
MAE	Mean absolute error
PCC	Pearsons correlation coefficient
RMSE	Root Mean Square Error
Scientific terms	
Boundary layer	The layer of the atmosphere from the Earth's surface to the level where the frictional influence is absent.
Odour unit	The number of times that a sample of odour must be diluted to reduce its concentration to its detection threshold. One odour unit is that concentration of odorant at standard conditions that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.

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Executive Summary

Air Environment Consulting was commissioned by Boral National (Boral) in June 2017 to undertake an odour impact assessment of the Alstonville asphalt plant during normal production. The asphalt plant has intermittently received complaints from the local community about odour emission releases over many years. In response to these complaints, Boral implemented an Air Quality Management Plan (AQMP) in 2014 that included the installation of an activated carbon filtration system to treat odour emissions released from the Bitumen Kettles / Holding Tanks during tanker loading. This odour control system has been highly effective at reducing emissions from this source. Notwithstanding this, the NSW Environmental Protection Authority (EPA) has noted that there have been verified odour complaints associated with asphalt production and handling under certain conditions since the implementation of the Bitumen Holding Tank odour control units.

To investigate the odour issue, an odour impact assessment comprising source odour sampling and laboratory olfactometry analysis was conducted in accordance with the relevant Australian standards (including AS4323.3 [2001] and AS4323.4 [2009]) and NSW Approved Methods techniques. An odour emissions inventory was then developed for use in a CALPUFF odour dispersion modelling assessment, conducted in accordance with the NSW Approved Methods and CALPUFF modelling guidance.

The odour impact assessment determined that ground-level odour concentrations associated with air emissions from all stack and fugitive sources combined were predicted to comply with the EPA odour impact assessment criterion at all sensitive receiver locations. This assessment was conducted on the basis of the plant's license conditions that allow for its operation during every hour of the year. In reality, the potential for the facility to cause odour impact was expected to be significantly lower than that assessed, as the plant only operated for 2.77% of the recent 2016-17 financial year.

The assessment also determined that emissions associated with the Dryer Kiln stack were the largest contributor to ground-level odour concentrations in sensitive residential areas adjacent to the plant. The second most important odour emission source was determined to be the truck load out facility for asphalt product. This conclusion was primarily due to the large difference in odour emissions between the two source types, where emissions from the stack were determined to be 20,444 OU/s compared to approximately 75 OU/s from all asphalt production sources combined. Also important to this finding was the configuration of the stack that was determined to be affected by turbulence generated by the flow of wind around the nearby plant buildings and structures that were of similar height to the top of the stack.

Notwithstanding the plant's compliance with the odour impact assessment criterion, in acknowledgement of the odour complaints from the community, Air Environment Consulting recommend that further investigations are conducted into their cause. These investigations would include:

- A series of ambient odour assessment surveys to be conducted around the plant and in the local community during production periods to track the odour plume and record its intensity,
- The keeping of an odour complaint log to assist in odour investigations including the establishment of a direct phone line that the community can use to register odour complaints,
- Liaison with the local community by Boral Alstonville operators to investigate the odour impact immediately upon the receipt of a complaint, and
- The analysis of wind and production conditions at the time of complaints based on data recorded at the on-site AWS.

It is also recommended that additional odour sampling and testing of fugitive and stack emissions be conducted to verify the odour emissions inventory. Supplementary odour testing is recommended to monitor odour emissions variability over time and under varying conditions, and their impact in the local area would be further assessed using the odour dispersion model developed for this assessment.

1 Introduction

Air Environment Consulting was commissioned by Boral to undertake an odour impact assessment of the Alstonville asphalt batching plant during normal production. The plant is situated at Alstonville in the hinterland approximately 10 km west-northwest of Ballina on the north coast of NSW.

The Boral Alstonville Asphalt Plant has intermittently received complaints from the local community about odour emission releases over many years. In response to these complaints, Boral implemented an Air Quality Management Plan (AQMP) in 2014 that included the installation of an activated carbon filtration system to treat odour emissions released from the Bitumen Kettles / Holding Tanks during tanker loading. This odour control system has been highly effective at reducing emissions from this source. Notwithstanding this, the NSW Environmental Protection Authority (EPA) has noted that there have been verified odour complaints associated with asphalt production and handling under certain conditions since the implementation of the Bitumen Holding Tank odour control units.

To further address recent odour complaints associated with asphalt production and handling, Boral committed to the development of a Bitumen Odour Management Plan (BOMP) for the facility. An odour impact assessment was commissioned to provide the foundation on which the BOMP would be developed. This assessment comprised sampling and olfactometry analysis of odour emissions from the:

- Produced asphalt, such as that transferred in the skip conveyor between the pug mill and hot asphalt storage bins and then dispensed into trucks,
- Bitumen holding tank vent during filling from a truck, and
- Dryer Kiln stack.

This report documents the methods, results, conclusions and recommendations for odour mitigation options of the odour impact assessment of the Boral Asphalt Plant in Alstonville. The assessment combines the site-specific details of the asphalt plant operations and surrounding environment, including odour emissions; topography; land use and the location of sensitive receptors, with predicted local meteorology evaluated against local observed meteorology to assess the potential for odour impact. The assessment was conducted in accordance with the methods promulgated in the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2007) and the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016)*. The predicted ground-level odour concentrations were assessed against the NSW odour impact assessment criterion of 2 OU, for a 1-second average, at the 99th percentile (i.e. during the 88th highest hour of the year), based on local population density.

2 Overview of the Assessment Methodology

The following approach to the odour impact assessment has been adopted:

- Selection of a representative year of regional meteorology for simulation.
- Development of a meteorological dataset using the CSIRO's prognostic meteorological model TAPM and the CALMET diagnostic meteorological model, which represents the three-dimensional wind flows and temperature profiles of the atmosphere in the region.
- Conduct of a site visit by Air Environment Consulting to design the odour emissions audit program for collection of relevant data for inclusion in the dispersion model and impact assessment.
- Undertaking of an odour emissions sampling program by Air Environment Consulting and Assured Monitoring Group (AMG), with olfactometry analyses conducted by AMG at their NATA accredited Brisbane odour laboratory.
- Prediction of ground-level odour concentrations in the local area using the CALPUFF dispersion model. CALPUFF input data comprised the following sources:
  - Three-dimensional wind fields generated by CALMET,
  - Results of the odour audit (Assured Monitoring Group, 2017),
  - Source characteristics information collected by Air Environment Consulting and AMG during their site visit, and
  - Information supplied by Boral regarding the site layout, plant dimensions and operations.

The assessment was conducted with regard for the following NSW policy and guidance documents:

- *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (2007),*
- *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016),*
- *Generic Guidance and Optimum Model Settings for the CALPUFF modelling system for Inclusion into the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, Australia (2011),*
- *Technical Framework - Assessment and Management of Odour from Stationary Sources in NSW,* (2006), and
- *Technical Notes - Assessment and Management of Odour from Stationary Sources in NSW* (2006).

The key site operations and odour emission sources investigated during the site visit included the following process areas:

1. Rotary dryer (kiln) stack emissions,
2. Dumping of asphalt from the Pug Mill to the Skip Conveyor,
3. Conveying of the asphalt from the pug mill to the Hot Asphalt Storage Bins by the Skip Conveyor System (the skip is uncovered during transit to the Hot Asphalt Storage Bins),
4. Dumping of asphalt from the Skip Conveyor into the Hot Asphalt Storage Bins,
5. Vented emissions from the Hot Asphalt Storage Bins (the Hot Asphalt Storage Bins remain uncovered throughout the process),
6. Dumping of asphalt from the Hot Asphalt Storage Bins into trucks,

7. Asphalt storage in uncovered trucks at the truck loading facility,
8. Asphalt storage in partially covered trucks at the site weighbridge, and
9. Filling of the heated Bitumen Storage Tanks (Kettles).

3 Project Overview

The Alstonville asphalt plant holds an environmental protection license that allows it to operate 24 hours per day, 365 days per year. Notwithstanding this, the plant is designed to operate as a batching-type asphalt plant. This means that during a typical production run, asphalt is produced in approximately three tonne batches. Consequently, not all plant processes operate or emit odour emissions on a continuous basis and at a constant rate.

The plant operates in response to the demand for its product. Road construction and maintenance is conducted by a range of customers at varying times, including varying hours of the day and on different days of the year, including weekends. Consequently, the plant needs to maintain operating flexibility in order to meet the requirements of its customers.

Asphalt is produced for road construction on a 'just in time' manufacturing basis. The asphalt is required to remain above a set temperature threshold that is specific to the product being produced and the distance it has to travel to the customer, in order for it to maintain the required properties for production, transit to site and application by the end user. Consequently, production rate and temperature are important considerations in the production process and the odour impact assessment. As asphalt can be produced at different temperatures, odour emissions released at two commonly used asphalt production temperatures, i.e. 165°C and 185°C, were sampled and analysed for the assessment, with the worst case odour emissions being used in the dispersion modelling assessment.

The total hours of production during the previous financial year, 1 July 2016 – 30 June 2017, was 242.9 hours (equivalent to 2.77% of the year), during which the total annual asphalt production was 16,172.11 t. The hourly breakdown of asphalt production for the 2016-17 year is presented graphically in Figure 3-1. The typical plant opening hours are between 6am and 3pm when 71% of the asphalt was produced in 2016-17. However, the production data shows that 73% of the asphalt was produced between the hours of 8am and 4pm, when total production was greater than 500 t in each hour. The other key production time is between 8pm and 11pm as road construction work is often scheduled at night when road use is reduced. This period accounts for 13% of the production by hour. Outside of these hours, production was well below a total of 500 t for each of the hours during the year and accounted for 14% of the total. The plant's average hourly production rate is approximately 75 t/h, with a maximum rate of 100 t/h.

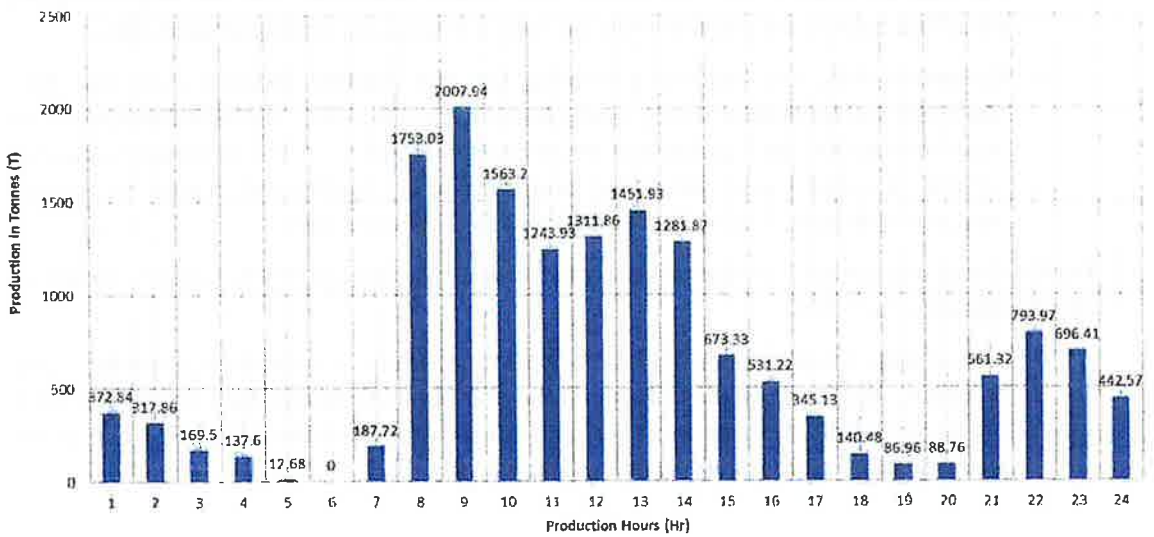


Figure 3-1 Total annual asphalt production by hour for 2016

3.1 Asphalt production process

An image illustrating the Alstonville plant components is presented in Figure 3-2. All components were investigated during the sampling program. The investigation determined that there are four main asphalt production process stages with the potential to generate odorous air emissions. These include:

- Aggregate heating and drying with air emissions released from the main Dryer Kiln Stack,
- Bitumen storage tanks,
- Asphalt batch production in the pug mill, transfer via an open top skip conveyor and storage in the hot asphalt storage bins, and
- Asphalt load out, truck parking while the load is either covered or partially.

During the sampling program, the following observations were made:

- Emissions from the main stack are not in any way connected to the bitumen application and handling process. These emissions are generated in the rotary kiln that is used to dry the aggregate prior to feeding it to the Pug Mill. Emissions from the main stack are based on the combustion of gas fuel to heat the kiln and the heating the aggregate (i.e. gravel).
- Emissions from the bitumen storage tanks (see Figure 3-3), of which there are two, are only released whilst the tank is being filled from a truck. On average, one tank is filled for every 400 t of production. On current production rates, this equates to an average of 1.2 truck loading events per week. One truck contains 25,000 L of bitumen and takes 40 minutes to decant it into the tank. All bitumen storage tank vent emissions are controlled through scrubbing via a carbon filtration unit prior to their release to atmosphere. No significant odour was observed in the vicinity of the bitumen tanks during the sampling program.
- Emissions from the asphalt batch production process are not continuous and are highly variable, such that:
    - Emissions are only released from the Pug Mill during asphalt dumping to the Skip Conveyor. Asphalt mix is batched in the Pug Mill through the combination of aggregate with heated bitumen.
    - Emissions are only released from the Skip Conveyor during dumping and transit to the Hot Asphalt Storage Bin (see Figure 3-4). Odour emissions from the skip during the return trip back to the pug mill when the skip is empty are considered to be minor.
    - Emissions from the building containing the Hot Asphalt Storage Bins and Skip Conveyor are continuous during production but are not static. These emissions can be seen coming from the building's open windows in Figure 3-5. The emission rate varies between a baseline emission during open storage bin venting and its peak during skip dumping to the bin. The open bins are illustrated in Figure 3-6.
- Truck loading and parking on site while loaded is a significant but highly variable source of odour emissions, such that:
    - Hot asphalt storage bin loading into trucks generates a short-term elevated odour emission. The loading doors beneath the Hot Asphalt Storage Bins are illustrated in Figure 3-7. This increase in odour emissions is significant but infrequent due to the limited number of truck loading events each hour.

— Trucks are partially covered with a retractable tarpaulin cover fitted over the truck's tray as the truck leaves the loading bay. The cover is not air tight and does not completely prevent emissions release.

— Once the truck and trailer loads are covered, the period of time that trucks remain on site while the driver processes the order and a sample of the asphalt is collected is also highly variable and was observed to be between five and ten minutes in duration.

— Observations during the site investigation showed that truck covering with tarps was not a 100 percent effective method of odour control or mitigation. Most truckloads were only covered by up to 90%, as shown in Figure 3-8.

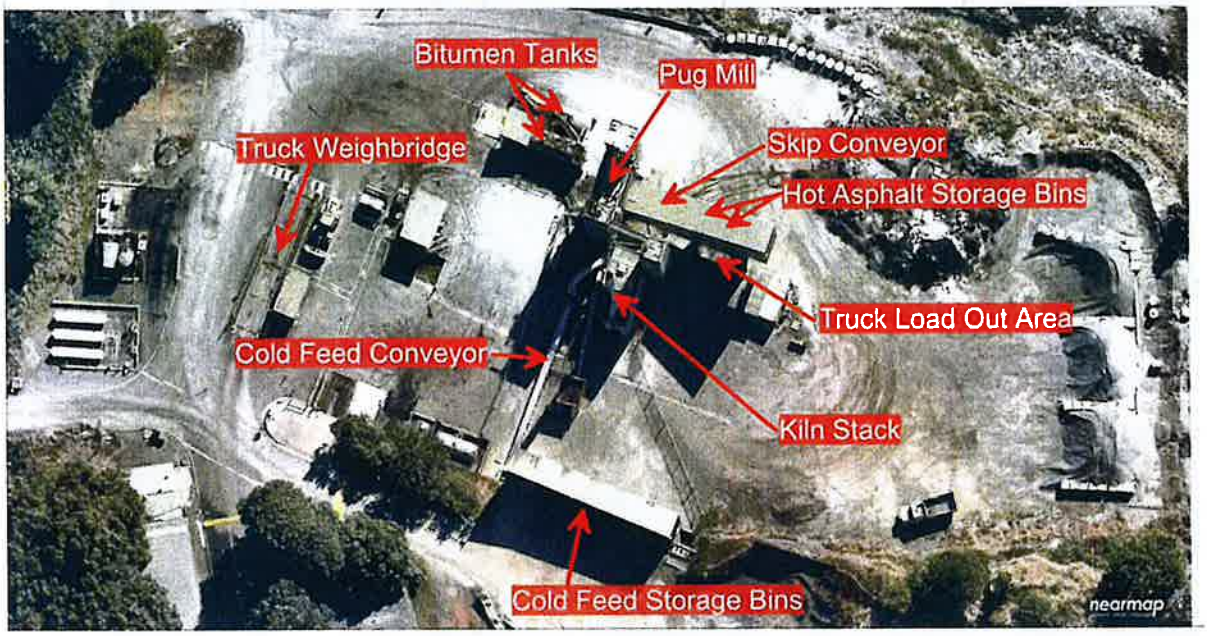


Figure 3-2 Alstonville plant process components and emission sources

Figure 3-3 Bitumen tanks (above) and carbon filtration units and vents (below) situated between the tanks

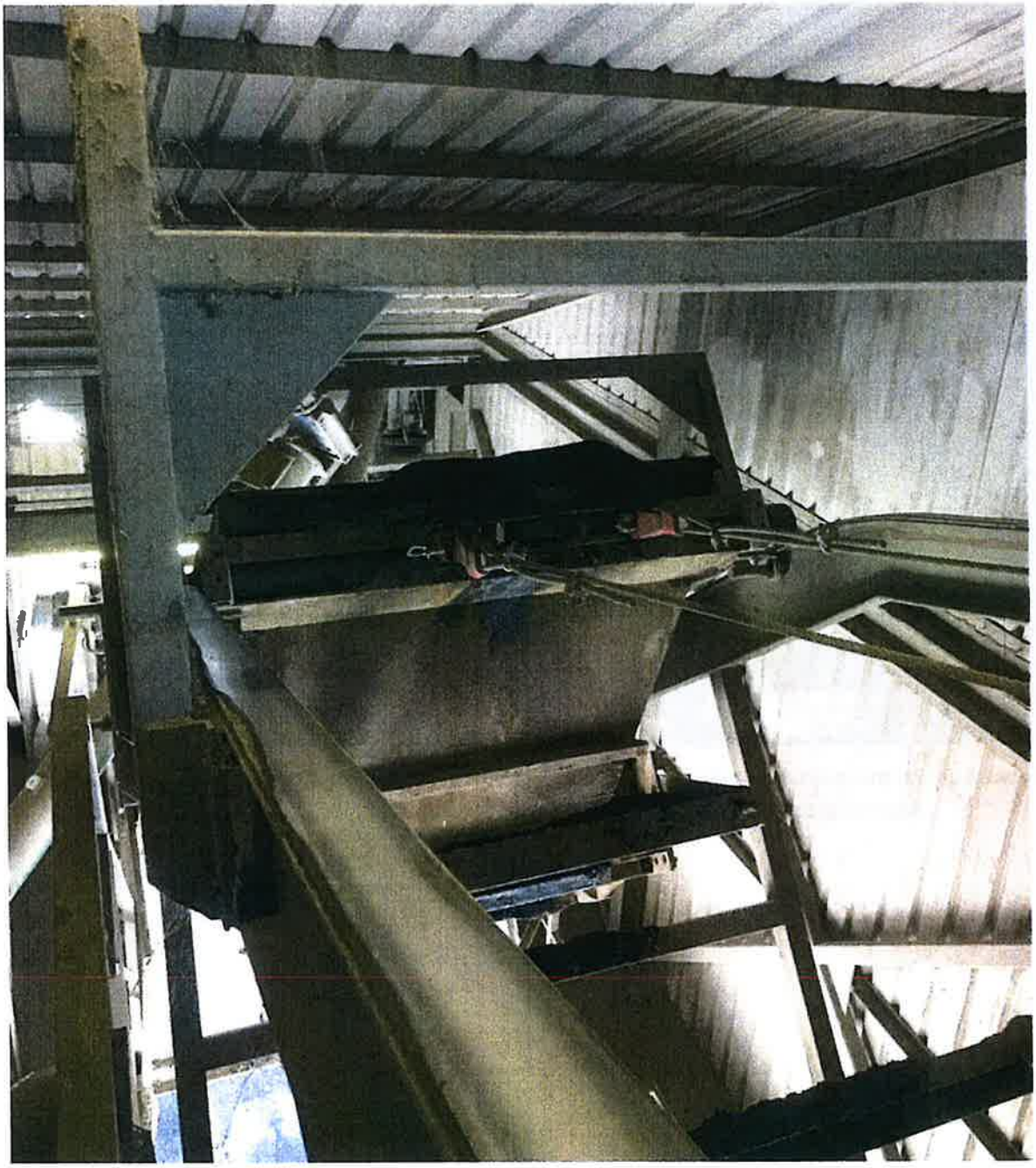


Figure 3-4 The loaded asphalt skip moving up the conveyor towards the Hot Asphalt Storage Bins

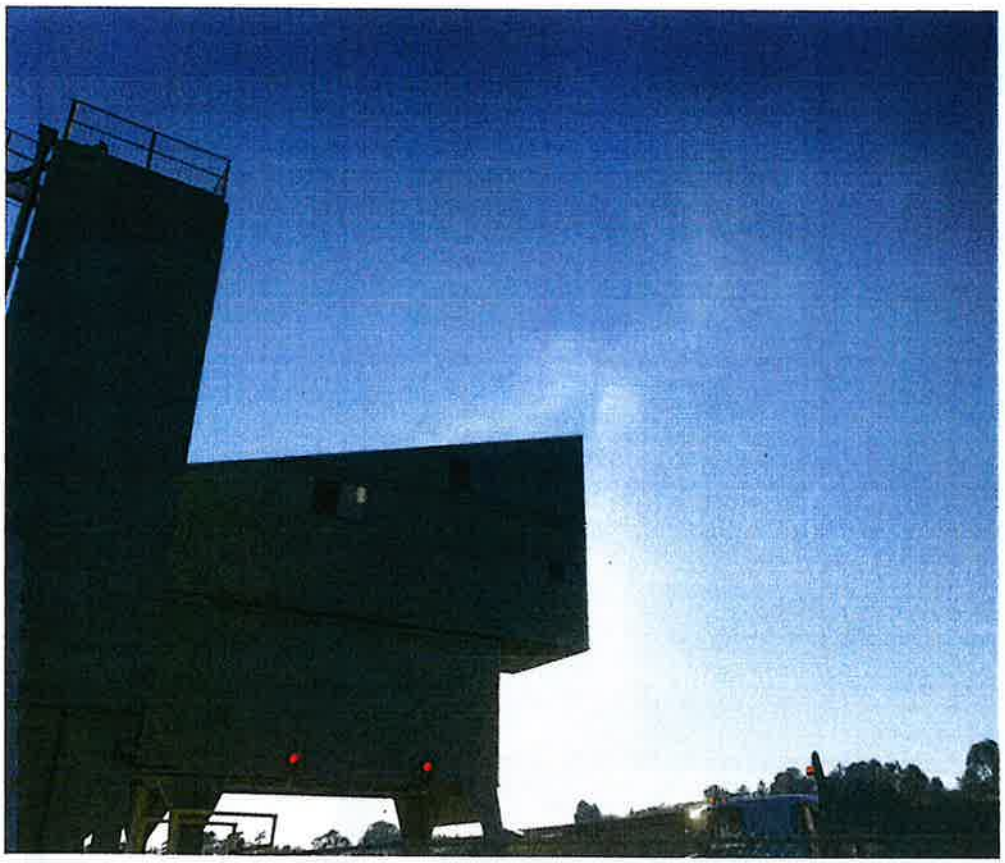


Figure 3-5 Plume emissions released from the building containing the Skip Conveyor and Hot Asphalt Storage Bins

Figure 3-6 Hot asphalt storage bin, with the skip conveyor approaching and preparing to be sampled

Figure 3-7 Truck asphalt loading facility under the hot asphalt storage bins

Figure 3-8 Partially covered loaded trucks on the weighbridge before leaving the site.

3.2 Odour sampling program

The Alstonville asphalt odour sampling program was conducted by Andrew Balch and Ella Castillo of Air Environment Consulting and David Arbuckle of AMG on 18 July 2017, after an initial site investigation was undertaken by Andrew Balch to develop the program on 16 December 2016. A total of eight odour samples were collected and returned to AMG's odour laboratory for analysis the following day within the prescribed 30-hour sample storage time limit.

Due to workplace safety issues, direct sampling from most sources at the plant was either difficult or not possible. As such:

- The Bitumen tank was sampled through a long sampling line between the vent and vacuum chamber, as an exclusion zone is enforced around the tanks during filling.
- A safety exclusion zone is also set up around the truck loading area during filling, where hot asphalt at 165 -185°C is dropped from the base of the Hot Asphalt Storage Bins into a truck. Consequently, it is difficult to get close enough to the truck and emission source to collect a representative sample and relevant airflow rate data.
- The Hot Asphalt Storage Bins and Skip Conveyor at the plant are contained within a partially enclosed building. Access to the building for sampling during conveyor operation and bin filling was not permitted for safety reasons.

In order to collect representative odour emissions data from asphalt at different temperatures and to meet both the requirements of the NSW EPA sampling methods and the Boral workplace safety policy, a flux chamber was used to collect odour samples from fresh asphalt loaded into a truck using the Australian standard AS4323.4 (2009) *Area Source Sampling – Flux Chamber technique.* This method provided for the determination of a specific odour emission rate (SOER) (in $OU/m^2/s$) that could be applied to the surface area of any asphalt exposed to the atmosphere in the plant.

The Kiln Stack was directly sampled using a sample line inserted into the stack at the sampling port and a sample vacuum chamber (drum and pump). Stack flow data was also measured.

The source emissions sampled from the plant are outlined in Table 3-1.

Table 3-1 Number of asphalt plant odour samples per emission source

Emission source	Sampling method	Sampling conditions		
		Constant temperature	Asphalt production temperature of 165°C	Asphalt production temperature of 185°C
Main Kiln Dryer stack	Sample line direct to a sample vacuum chamber	N/A	1	1
Hot asphalt in truck tray	Flux chamber placed on asphalt after truck loading	N/A	2	2
Bitumen tank vent (post-carbon filtration unit)	Sample line direct to a sample vacuum chamber	2	N/A	N/A

4 Odour Emissions Survey Results

4.1 Odour sampling and testing

The site odour emissions survey was conducted by AEC and AMG on 18 July 2017. The AMG test report is presented in Appendix A, and includes details of the sampling and testing methodologies. The odour emissions test data is summarized in Table 4-1.

There are two key types of odour emissions from asphalt production facilities based on odour character:

1. The dryer kiln, and
2. The production of asphalt where hot bitumen and aggregate, dried in the kiln, are mixed, stored and dispensed.

Emissions from the Dryer Kiln Stack and Bitumen Tank Vents are considered to be point sources while all other asphalt handling sources are fugitive releases that may be characterised as either area or volume sources. Consequently, the point sources were sampled directly with a vacuum chamber while the fugitive releases were sampled by using a flux chamber on exposed asphalt surfaces. This provided for the application of an SOER within the dispersion model to any asphalt area exposed to the atmosphere.

Table 4-1 Summary of odour emissions survey data

Emission source	Asphalt production temperature (°C)	Odour concentration (OU)	Specific odour emission rate ($OU/m^2/s$)	Odour emission rate (OU/s)
Dryer kiln stack	165	1,260	N/A	15,241
	185	1,690	N/A	20,444
Hot asphalt	165	964	0.62	N/A
	165	639	0.53	N/A
	185	857	0.55	N/A
	185	568	0.55	N/A
Bitumen tank vent	N/A	399	N/A	4.2
	N/A	423	N/A	4.4

Table note: Odour concentrations are presented as three significant figures.
Two concurrent flux chamber samples were collected side by side from the back of a truck using flux chambers with slightly different dimensions, hence the difference in concentrations but similarity in SOERs.

The odour survey was representative of conditions at the time of sampling. Observations made around the Alstonville site at the time of the odour sampling indicated that ambient odour levels were very low. Little to no asphalt odour was experienced in the main production areas and in the location of the main site office, staff room and carpark area near the site's front gate.

Whilst the odour emissions data for each sampled source were found to be consistent with one another, the exposed asphalt mix odour concentrations and emission rates were lower, and the Dryer Kiln stack emissions higher, than expected from our experience at other sites. That being said, they were consistent with observations made on the day.

Subsequently, the odour dispersion modeling and impact assessment was conducted by assessing the highest odour emission conditions observed at the site on the day of the survey against all meteorological conditions (i.e. during all hours) in a representative year.

4.2 Odour intensity testing

The perception of odour strength is an important component of the FIDOL (Frequency, Intensity, Duration, Offensiveness and Location) factors that characterise odour nuisance in the ambient environment. The 'I' in FIDOL represents the odour's intensity or strength perceived by the receptor and differs from the odour's concentration which is measured in odour units. However, the relationship between an odour's concentration and it's perceived intensity, as detected by a receptor, is not linear. This relationship is important to the overall nuisance value when odours from different sources are compared to one other. The relationship is important in that it goes partly to explain why one odour can be perceived to be stronger or worse than another odour when both are at the same concentration.

To investigate the odour concentration-intensity (OCI) relationship further, odour intensity testing in accordance with the German standard *VDI3882.1 Determination of Odour Intensity* (VDI, 1992) was conducted on samples collected from the Dryer Kiln Stack, the Bitumen Tank Vent, and the asphalt surface for asphalt mix produced at a temperature of 165°C and 185°C. The VDI3882.1 intensity ranking system is summarised in Table 4-2. The observed relationships between odour concentration and intensity are illustrated in Figure 4-1.

Table 4-2 Odour intensity ranking system

Intensity ranking	Description
0	Not detectable
1	Very weak
2	Weak
3	Distinct (moderate)
4	Strong
5	Very strong
6	Extremely strong

Table note: The correct interpretation of the intensity rank 'distinct' is an odour that is stronger than weak and weaker than strong. The distinct odour intensity level should not be considered equivalent to the odour's recognition threshold.

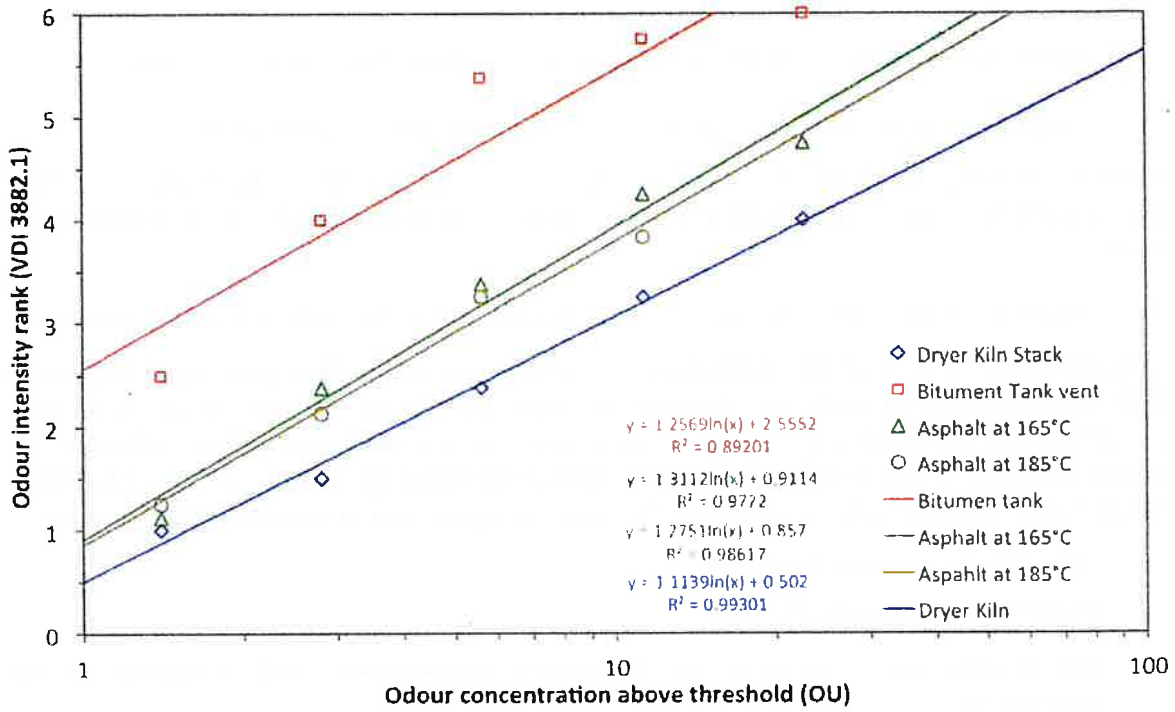


Figure 4-1 Relationships between odour intensity and the concentration above threshold for various sources

The OCI relationships presented in Figure 4-1 indicate that the Dryer Kiln emissions are significantly less intense at the same odour concentrations to that of the asphalt mixes at different temperatures and the Bitumen Tank emissions. Furthermore, the Bitumen Tank emissions are perceived as significantly more intense than the asphalt mix and Dryer Kiln emissions, even though they have been treated through a carbon filter. This is a curious result given that the odour has been treated and the odour concentration was determined to be very low by comparison to the other sources. The OCI relationships for the asphalt mixes at different temperatures are very similar. The OCI relationships are detailed in Table 4-3.

Table 4-3 Odour concentration – intensity relationships for various sources

Intensity rank	Odour concentration above threshold (OU)			
	Dryer Kiln	Bitumen Tank	Asphalt mix at 165°C	Asphalt mix at 185°C
1	1.6	0.3	1.1	1.1
2	3.8	0.6	2.3	2.4
3	9.3	1.4	4.8	5.3
4	22.6	3.1	10.2	11.5
5	55.1	6.9	21.6	25.2

5 Legislative Requirements, Context and Odour Assessment Criteria

5.1 Legislative framework for air quality and odour impact assessment

Odour is the primary pollutant of concern in regard to the Boral Asphalt facility at Alstonville. The NSW odour impact assessment legislative framework and impact assessment criteria are discussed in this section.

5.2 Relevant NSW statutory requirements for the protection of the air environment

In accordance with *Part 5 of the Protection of the Environment Operations (Clean Air) Regulation (2010): Emission of Air Impurities from Activities and Plant*, the statutory methods that are to be used for modelling and assessing emissions of air pollutants from stationary sources are outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016)* (EPA, 2016). The Approved Methods provides guidance on the air quality impact assessment process including the:

- Preparation of emission inventories,
- Preparation of meteorological data,
- Quantification and accounting for background concentrations and cumulative impact assessment,
- Dispersion modelling methodology,
- Presentation and interpretation of dispersion model predictions, and
- Impact assessment criteria and assessment outcomes.

The Approved Methods also prescribes two levels of impact assessment:

1. Level 1 – screening-level dispersion modelling technique using worst case input data.
2. Level 2 – refined dispersion modelling technique using site-specific input data.

The assessment levels are designed so that the second level of assessment should be more accurate than the first, but that the first level is more conservative than the second. The intention of the assessment level system is not to conduct a level two assessment upon completion of a level one assessment, particularly if the level one assessment adequately demonstrates that the development is not expected to cause an impact to the air environment in relation to the impact assessment criteria.

In accordance with the guidance provided in EPA (2016), the assessment of key plant infrastructure for the project has been conducted as a level two impact assessment through the use of site-specific input data, including:

- Local terrain and land use,
- Actual locations of sensitive receptors,
- TAPM prognostic model simulations over the region,
- Configuration of the CALPUFF dispersion model using site-specific emission source characteristics, dimensions and coordinate locations,
- Odour emission rate estimates based on site-specific sampling data.

5.3 Odour assessment framework

In addition to the Approved Methods (EPA, 2016), the principal document that sets out the framework for the management and assessment of odour impacts in NSW is the *Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW (2006) (the Framework).* The framework aims to *protect the environment and community from the impacts of odour emissions while promoting fair and equitable outcomes for the operators of activities that emit odour* (DEC, 2006).

In order to equitably manage odour in the community, the framework recognises that (DEC, 2006):

- *Sustainable land-use planning and management is needed to avoid odour impacts, because land uses will change over time to meet altered industry and societal needs;*
- *Avoiding odour impacts is a shared responsibility between operators and local land-use planners. However, the operator of an activity that emits odour must ultimately be responsible for managing odour impacts of the operation beyond its boundary; and*
- *Emissions of odour may not be preventable from some activities. "No odour" is not a realistic objective.*

The key principles of the odour management framework include:

- **Planning to prevent and minimise odour** including consideration of the compatibility of the proposal with existing and future nearby land uses to ensure the best possible environmental outcomes;
- **Use of a range of strategies to manage odour** depending on the type of odour sources, the characteristics of the odour emissions i.e. frequency, intensity, duration and character and the impact of emissions; and
- **Ongoing environmental improvement** due to the dynamic nature of land use. Existing activities must be prepared to undertake measures to minimise their odour impacts if conflicts arise and should adopt a risk management approach that provides contingency for possible future land use changes.

The odour management framework establishes three levels of impact assessment in order that an appropriate level of odour investigation can be carried out depending on whether the proposed odour-emitting activity is new, modified or existing.

- **Level 1 Assessment**: is a simple screening-level technique based on generic parameters for the type of activity and site. It requires minimal data and uses simple equations designed to indicate the likely extent of any odour impact. It may be used to assess site suitability and odour mitigation measures for new or modified activities.
- **Level 2 Assessment**: is a screening-level dispersion modelling technique, using worst-case input data (rather than site-specific data). It is more rigorous and more realistic than a Level 1 assessment. It may be used to assess site suitability and odour mitigation measures for new, modified or existing activities.
- **Level 3 Assessment**: is a refined-level dispersion modelling technique using site-specific input data. This is the most comprehensive and most realistic level of assessment available. It may be used to assess site suitability and odour mitigation measures for new, modified or existing activities.

In accordance with the guidance provided in the Odour Framework, this assessment has been conducted as a Level 3 odour impact assessment.

5.3.1 Odour impact assessment criteria

The NSW impact assessment criterion for complex mixtures of odours has been *designed to take into account the range of sensitivity to odours within the community and to provide additional protection for individuals with a heightened response to odours. This is achieved by using a statistical approach dependent upon population size. As the population density increases, the proportion of sensitive individuals is also likely to increase, indicating that more stringent criteria are necessary in these situations.* (EPA 2016)

The following equation can be used to determine the appropriate odour impact assessment criterion. This equation has been used to determine the criteria summarised in Table 5-1, and as shown in the Approved Methods (EPA, 2016, pp. 35-36):

$$\text{Impact assessment criterion (OU)} = \frac{(log10\,(population) - 4.5}{-0.6}$$

Table 5-1 Impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

Table note: Source: EPA (2016, p.36)

The Alstonville plant is situated in a relatively populated area with a population greater than 2,000 people, providing for an odour impact assessment criterion of 2 OU.

For odour generating activities licensed to operate on a continuous basis or in any hour of the year, the odour impact assessment criterion is assessed against the 99th percentile model predictions (based on continuous emissions over an entire year (i.e. 8,760 hours). This is equivalent to the 88th highest hour of dispersion model predicted impacts. The criterion applies at sensitive receiver locations. Although the Alstonville asphalt plant only operated for 242.9 hours in the 2016-17 year, it has been assessed based on continuous operation and constant emissions for the period. The odour impact assessment criteria used in the assessment is presented in Table 5-2.

Table 5-2 Odour impact assessment criteria used in the assessment

Pollutant	Averaging period	Statistic (percentile)	Assessment criterion	Source
Odour	1-second	99.0th	2 OU	DEC (2001)[1]

Table note: [1] The source is the original document in which the criterion was promulgated.

6 Existing Environment

6.1 Location of facility

The Alstonville asphalt plant is situated at the site of a former quarry operated by Ballina Shire Council at 540 Gap Road, Alstonville in northern NSW. The setting is semi-rural with residential developments situated as close as approximately 310 m to the south and 420 m to the west of the plant's boundaries. Scattered isolated residences and businesses are also situated between the plant and these developments as well as in other directions.

There are no other industries in the local area that release significant levels of odour emissions that are similar to asphalt, consequently, the modelling assessment has been prepared in isolation with no cumulative off-site sources.

The location of the Alstonville project site is illustrated in Figure 6-1.

Figure 6-1 Maps showing project site location

7 Odour Emissions Inventory used in the Dispersion Model

This section details the odour emission source characteristics and emission rates configured in the air dispersion model.

All sources at the facility, with the exception of the Dryer Kiln stack, were considered to be fugitive emission sources and consequently, were modelled as individual volume sources. This included the vents on each of the two Bitumen Tanks as they were situated between the tanks, which caused the plumes to be significantly wake-affected. While the Dryer Kiln stack is relatively tall at 18.3 m above ground level, there are several tall building structures and trees in close proximity to the stack that cause turbulence in the nearby wind flows and effect the plume's dispersion. This turbulence was determined to affect the stack plume's dispersion.

The odour emissions inventory was based on information collected during the site investigation, information supplied by Boral and a range of conservative assumptions, as presented in Table 7-1. The modelled configurations for the volume sources are presented in Table 7-2. Stack characteristics used in the dispersion model are presented in Table 7-3.

Table 7-1 Assumptions used in the emissions and dispersion model configuration

Odour emission source	Details	Source dimensions and emissions
Skip Loading	Skip conveyor batch loading emissions were based on the maximum measured SOER for asphalt. The emission area was assumed to be similar to a continuous curtain of asphalt falling from the Pug Mill into the skip at a height of 0.36 m with a width of 1.65 m, which was equivalent to the skip opening width. Skip loading is intermittent as the Pug Mill produces batches as asphalt and the skip conveys the product to the Hot Asphalt Storage Bin.	Skip opening width: 1.65 m; Curtain area: 0.36 x 1.65m = 0.594 m^2 per side, two sides modelled for total area of 1.188 m^2; SOER: 0.62 OU/m^2/s; OER: 0.74 OU/s
Skip Conveyor	SOER based on the maximum measured SOER for asphalt. Source area dimensions based on skip length of 1.65m and width 1.3 m. As this source is mobile, it was assumed to be situated halfway between the Pug Mil and the top of the Hot Asphalt Storage Bins at a height of 11 m above the ground. Asphalt is in the skip intermittently as batches of asphalt are produced and conveyed to the Hot Asphalt Storage Bin. Furthermore, the skip is generally in motion when loaded with asphalt.	Area of top of skip: 2.145 m^2; SOER: 0.62 OU/m^2/s; OER: 1.34 OU/s.
Truck Load Out Facility	Fugitive emissions from the top of the two Hot Asphalt Storage Bins. Baseline emissions from the Hot Asphalt Storage Bins are only constant when material is in the bins. Emissions are negligible when the bins are empty.	Storage bin opening area: 12 m^2 (6m^2 per bin) SOER: 0.62 OU/m^2/s; OER: 7.48 OU/s.
	Hot Asphalt Storage Bin loading events from the Skip Conveyor. Emissions tend to increase for a short duration (i.e. several seconds only) when the skip conveyor dumps a fresh batch of asphalt into the bin.	Skip opening width: 1.65 m; Estimated drop height: 2 m; Curtain area: 2 x 1.65 m = 3.3 m^2 per side, two sides modelled for total area of 6.6 m^2; SOER: 0.62 OU/m^2/s; OER: 4.12 OU/s.
	Truck loading event. Emissions tend to increase for a short duration (i.e. up to	Length of Hot Asphalt Storage Bin opening (approximately equivalent

Odour emission source	Details	Source dimensions and emissions
	30 seconds only) when a truck is loaded. Up to eight trucks per hour are loaded during maximum production.	to width of trucks): 2.4 m^2; Drop height: 1.5 m Curtain area: 3.6 m^2 per side, two sides modelled for total area of 7.2 m^2; SOER: 0.62 OU/m^2/s; OER: 4.49 OU/s.
	Uncovered truck in the loading bay prior to being covered. A maximum of eight trucks per hour are loaded. On occasion two trucks could be present and loaded on the site at the same time. Trucks are typically present and loaded on the site for less than 10 minutes.	Truck tray dimensions: 6.2 x 2.4 m; Area: 14.88 m^2; SOER: 0.62 OU/m^2/s; OER: 9.28 OU/s.
Covered Loaded Truck at the Weighbridge	Trucks remain partially uncovered (approximately 10% of the tray area is exposed) whilst on site and at the weighbridge during check out. Trucks remain on the weighbridge for several minutes whilst the driver processes the load with the control room.	Truck height: 2.4 m; Uncovered portion of truck tray area: 1.49 m^2; SOER: 0.62 OU/m^2/s; OER: 0.93 OU/s.
Bitumen Tank during filling	It was assumed that the odour emissions during tank filling were greater than that which occurs during normal tank breathing due to the displacement of air by bitumen. 25,000 L of bitumen is dispensed into the tank from a trucker per load. This takes approximately 40 minutes to complete. Consequently, the tank air displacement or emission flow rate is 0.0104 m^3/s. Tank vents are assumed to be emitting constantly during filing. Emissions are scrubbed through a carbon filtration unit. There are negligible emissions at all other times.	Maximum observed odour concentration: 423 OU; Volume flow rate: 0.0104 m^3/s; OER: 4.16 OU/s. Assumed to be continuous even though tank filling events are likely to be restricted to between 6am and 3pm.
Dryer Kiln stack	Assumed continuous emissions from stack.	Maximum observed odour concentration: 1,690 OU; OER: 20,444 OU/s.

Table 7-2 Fugitive volume source characteristics

Odour source	Source centre coordinates (m)		Dimension characteristics		Base elevation (m)	Effective height (m)	OER (OU/s)	OER with peak to mean (OU/s)
	Easting	Northing	σ_y	σ_z				
Bitumen Tank	544286	6809907	1.63	0.84	128	3.6	4.16	9.57
Skip Loading	544295	6809898	0.38	0.86	128	3.7	0.74	1.70
Skip Conveying	544307	680989	0.38	2.56	127	11	1.34	3.08
Truck Load Out Building	544315	6809892	1.16	4.26	127	9.1	25.37	58.35
Truck at Weighbridge	544248	6809886	0.56	0.56	131	2.4	0.93	2.13

Table note: Coordinates are in Universal Transverse Mercator (UTM), equivalent to Map Grid of Australia (1994).

Table 7-3 Main Dryer Kiln stack characteristics

Odour source	Source coordinates (m)		Stack height above ground (m)	Stack diameter (m)	Stack velocity (m/s)	Stack gas temperature (°C)	OER (OU/s)
	Easting	Northing					
Stack	544295	6809886	18.3	1.06	14.9	84.0	20,444

Table note: Coordinates are in Universal Transverse Mercator (UTM), equivalent to Map Grid of Australia (1994).
Odour emission rate in table does not include peak to mean factor applied in the model.
The stack plume has a buoyancy flux factor of 6.8 m^4/s^3.

The NSW Approved Methods approach prescribes the use of peak to mean factors to account for meteorological variability within each hour. The factor is designed to account for the discrepancy between the hourly averaged model time step and the peak ground-level odour concentration, effectively the nose-response time, of human receptors, which is assumed to be one second. EPA (2016, p.22, Table 6.1) presents peak to mean factors for a range of source types for varying atmospheric stability conditions. A peak to mean factor has been applied to the emission rate of each odour source modelled (i.e. the emission rates presented in Table 7-2 and Table 7-3 above, based on the information in EPA (2016), and the assumption that the point source (Dryer Kiln stack) is wake-affected.

Consequently, the following peak to mean factors have been applied:

- Wake-affected point source: 2.3, and
- Volume (fugitive) source: 2.3.

It is also acknowledged that the odour emission rates for many of the fugitive sources are of short duration, are highly variable and intermittent. Significant short-term fluctuations in ground-level odour concentrations are likely to occur beyond the site boundary due to the intermittent and variable nature of the asphalt batching process and its emissions profile. These are then likely to be compounded further by fluctuations in meteorological dispersion processes.

The meteorological variability has been accounted for by the application of the prescribed peak to mean factor. This assessment has adopted the conservative approach of assuming that all emission sources are continuous in nature rather than intermittent, and are therefore all in simultaneous operation at their peak rate throughout each second of a modelling hour. This approach effectively pairs the worst-case 1-second emissions in any given hour with the meteorological variations resulting in peak concentrations during that hour.

8 Air Quality Impact Assessment Methodology

8.1 Selection of a representative year of meteorology

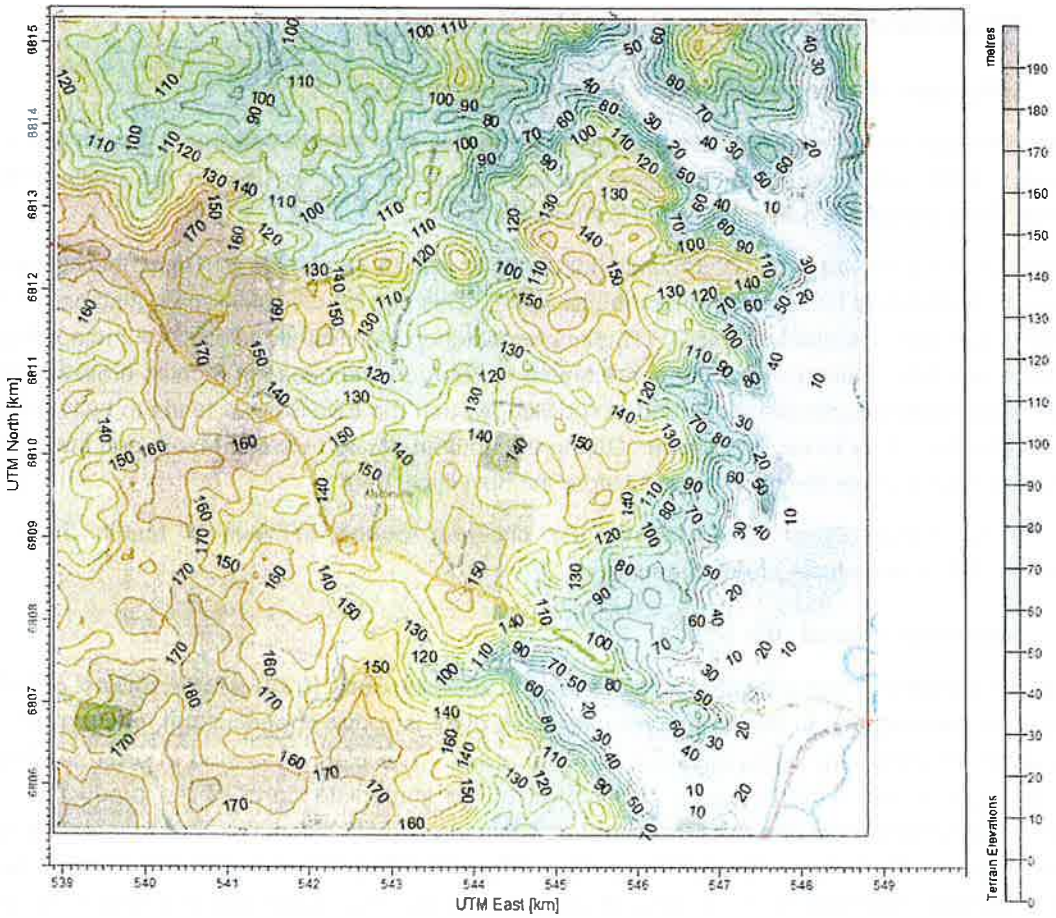
A detailed analysis of the regional meteorology over the five-year period between 1 March 2011 and 29 February 2016 was undertaken to select the representative year to use for the meteorological simulation. This analysis is presented in full in Appendix B.

The selection of months based on a conventional calendar year (1 January to 31 December) separates the summer season into two periods nine months apart. This can be critical in some instances where the El Niño Southern Oscillation (ENSO) climatic phenomenon significantly affects the meteorology of consecutive summer seasons. The use of the March to February sequence of months provides for the inclusion of complete seasonal periods and acknowledges that the ENSO trend tends to build annually from approximately June through to March. During the autumn period between March and May, ENSO tends to transition towards the neutral state before the next cycle begins.

Based on the outcomes of the analysis, the one-year period between 1 March 2012 and 28 February 2013 was selected for the modelling.

8.2 Terrain and land use

The Alstonville Asphalt Plant is located in the hinterland approximately 10 km west-northwest of Ballina. The land use classification in the area surrounding the plant is a mix of agricultural, pastoral and low density urban development with occasional forested areas. The plant is located in a former Council owned quarry site with a large quarry pit situated to the immediate north of the production area. Elevation ranges from approximately 0 m to 190 m within the CALMET domain. The topography within approximately one kilometre of the facility is only mildly undulating, however there is elevated terrain located at greater distances to the southwest and west of the site. Land use and terrain within the CALMET meteorological grid domain is illustrated in Figure 8-1.



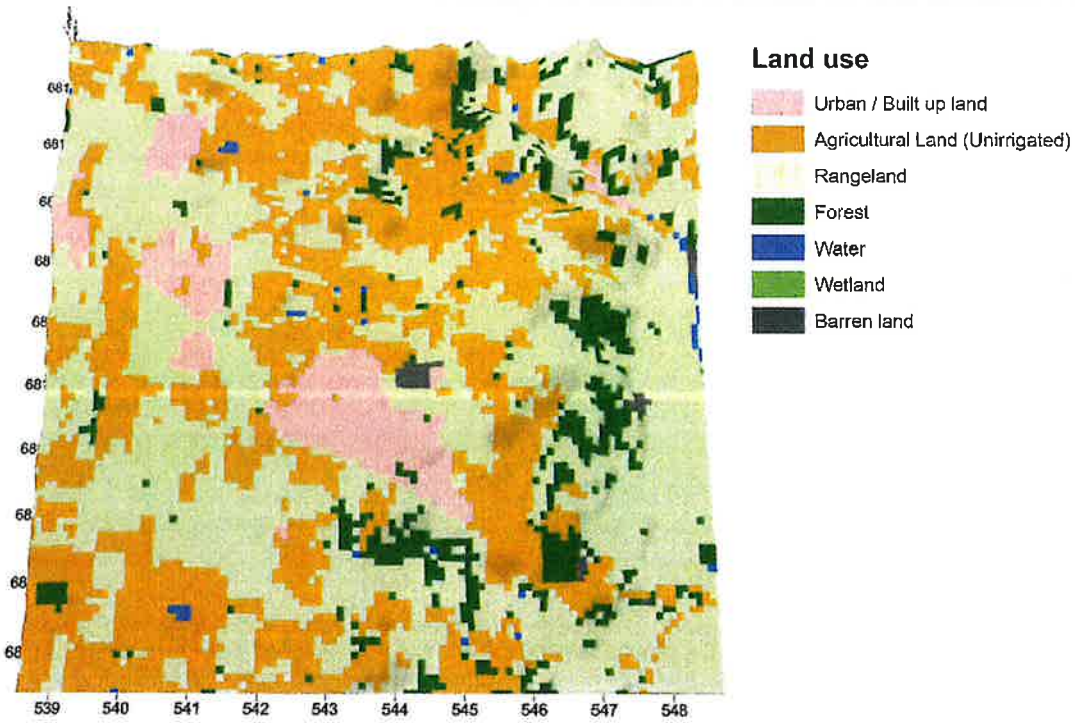


Figure 8-1 CALMET meteorological model grid domain showing terrain (top) and land use (below)

8.3 Meteorological modelling

The meteorological file used in the air dispersion model was developed using the TAPM-CALMET two-stage model suite. TAPM was run to develop a three-dimensional simulation of the atmosphere in the region for direct input to the CALMET model. CALMET was then used to downscale the three-dimensional regional meteorological profile developed using TAPM to incorporate the local geophysical environment, i.e. topography and land use variables. The CALMET output file is formatted for use in the CALPUFF dispersion model.

All models were configured in consideration of the document *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the Approved Methods for the Modeling and Assessment of Air Pollutants in NSW, Australia (2011)* [OEH, 2011].

8.3.1 TAPM prognostic meteorological model

The Air Pollution Model (TAPM) was developed by CSIRO for use in simulating regional meteorological and air pollution events. TAPM is a coupled mesoscale prognostic meteorological and air dispersion modelling system designed to operate on a standard desktop computer.

The model requires synoptic meteorological information inputs for the region of interest that are generated by a global model similar to the large-scale models used to forecast the weather. TAPM incorporates re-analysed and validated synoptic weather forecast data at a resolution of approximately 75 km and at elevations of between 100 m and 5,000 m above the surface with regionally-specific terrain, land use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

Landcover data for TAPM are sourced from the US Geological Survey, Earth Resources Observation Systems (EROS) Data Center Distributed Active Archive Center (EDC DAAC) at 30-second (approximately 1 km) grid spacing.

It is essential to accurately represent the geophysical features of the modelling domain. Geophysical parameters such as vegetation height, fraction of surface covered by vegetation and leaf area index are derived from land cover classification.

Where required, terrain and land-use data generated from the TAPM default database was improved. This could include a visual analysis of available imagery and may also include more complex methods using spatial analysis and techniques based on GIS (Geographic Information Systems).

TAPM (v. 4.0.5) was configured as follows:

- Modelling period of one year from 1 March 2012 to 28 February 2013,
- 35 x 35 grid point domain with an outer grid of 30 km and nesting grids of 10 km, 3 km, 1 km, and 300 m,
- 30 vertical levels from the surface up to 8,000 m above the ground,
- Grid centred near project site (latitude -28° 50', longitude 153° 27'),
- Terrain data for all nests based on Geoscience Australia 9 second (approximately 300m) terrain data,
- Land cover data based on land use database created from NSW Landuse Mapping Program, Standard Classification for Attributes of Land, Australian Landuse and Management Classification. The land use classes were overlaid with the most recent aerial imagery to ensure any updates were covered,

- Default options selected for advanced meteorological inputs, and
- No data assimilation.

8.3.2 CALMET diagnostic meteorological pre-processor

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data assimilated from multiple sites within the modelling domain however it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM.

CALMET (version 6.334) was used to simulate meteorological conditions in the region. The TAPM prognostic grid data was used by the CALMET diagnostic model as an 'initial guess' before making adjustments to the local wind fields for the kinematic effects of terrain, slope flows, blocking effects and three-dimensional divergence minimisation. The TAPM-CALMET coupled approach improves the mesoscale prognostic simulation generated by TAPM with the refined local-scale land use and terrain capabilities of CALMET. The CALMET output provides a complete set of three-dimensional wind fields, temperature profiles and other important meteorological variables throughout the atmosphere for application in the simulation of plume dispersion.

CALMET was configured as follows:

- Domain area of approximately 10 km x 10 km at a resolution of 100 m grid spacing,
- 12 vertical levels with cell face heights (in metres) at 0, 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600, and 4600 m,
- Year modelled: 1 March 2012 to 28 February 2013,
- Terrain data based on the near-global 3-second (~90 m) Digital Elevation Model (DEM) produced by the Shuttle Radar Topography Mission (SRTM), a project of the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) program (CGIAR, 2017),
- Land cover data based on customised land use database consistent with the dataset used to create the TAPM geophysical dataset,
- No observations mode. TAPM generated prognostic meteorological inputs as a CALTAPM.M3D file used as an 'initial guess' field,
- Coriolis parameter calculated for the area,
- Terrain radius of influence of 2 km,
- Model options guided by the recommendations outlined in the NSW Modelling Guidance document (OEH, 2011), and
- All other options set to default.

8.3.3 Meteorological model performance evaluation

To assess model performance, observations taken at the Bureau of Meteorology (BOM) automatic weather station site at Ballina Airport during the period corresponding to the period for modelling were compared with the meteorological data generated by the TAPM/CALMET meteorological modelling system. The model performance evaluation shows that the meteorological dataset generated by the TAPM/CALMET modelling system is representative and suitable for use in dispersion modelling.

Details of the model validation are presented in full in Appendix B.

8.4 Analysis of dispersion meteorology

This section describes the meteorology used in the CALPUFF model that is important to the dispersion of air pollutants and the generation of air quality impacts.

8.4.1 Wind direction and speed

Wind speed and wind direction are important meteorological parameters that influence the dispersion of air pollutants. The annual, seasonal and diurnal distributions of surface (i.e. 10 metres above ground) winds predicted at the Boral Alstonville Asphalt Plant site, by the TAPM/CALMET meteorological modelling system for 1 March 2012 to 28 February 2013, are presented as wind rose diagrams in Figure 8-2, Figure 8-3, and Figure 8-4, respectively.

The annual wind rose (Figure 8-2) indicates that the modelled winds tend to be well distributed throughout the sectors with the prevailing winds blowing from the south-southeast to southeast sector. Winds also frequently arrive from the southwest and north to north-northeast sectors but rarely flow from the northwest to west-northwest sectors. Calm conditions, where the wind speed is lower than 0.5 m/s, are rare occurring on only 0.4 % of occasions, with the annual mean wind speed being 3.2 m/s. The lightest winds tend to arrive from the southeast quadrant.

The diurnal wind distribution is presented in Figure 8-3 and shows that stronger winds are more common during the day, with more instances of south-southeasterly and southeasterly winds during the afternoon. At night winds most frequently arrive from the southwest quadrant. Figure 8-4 shows that during summer and autumn winds are more likely to originate from the south-southeast and southeast, with southwesterly and northerly winds prevailing during winter and spring respectively.

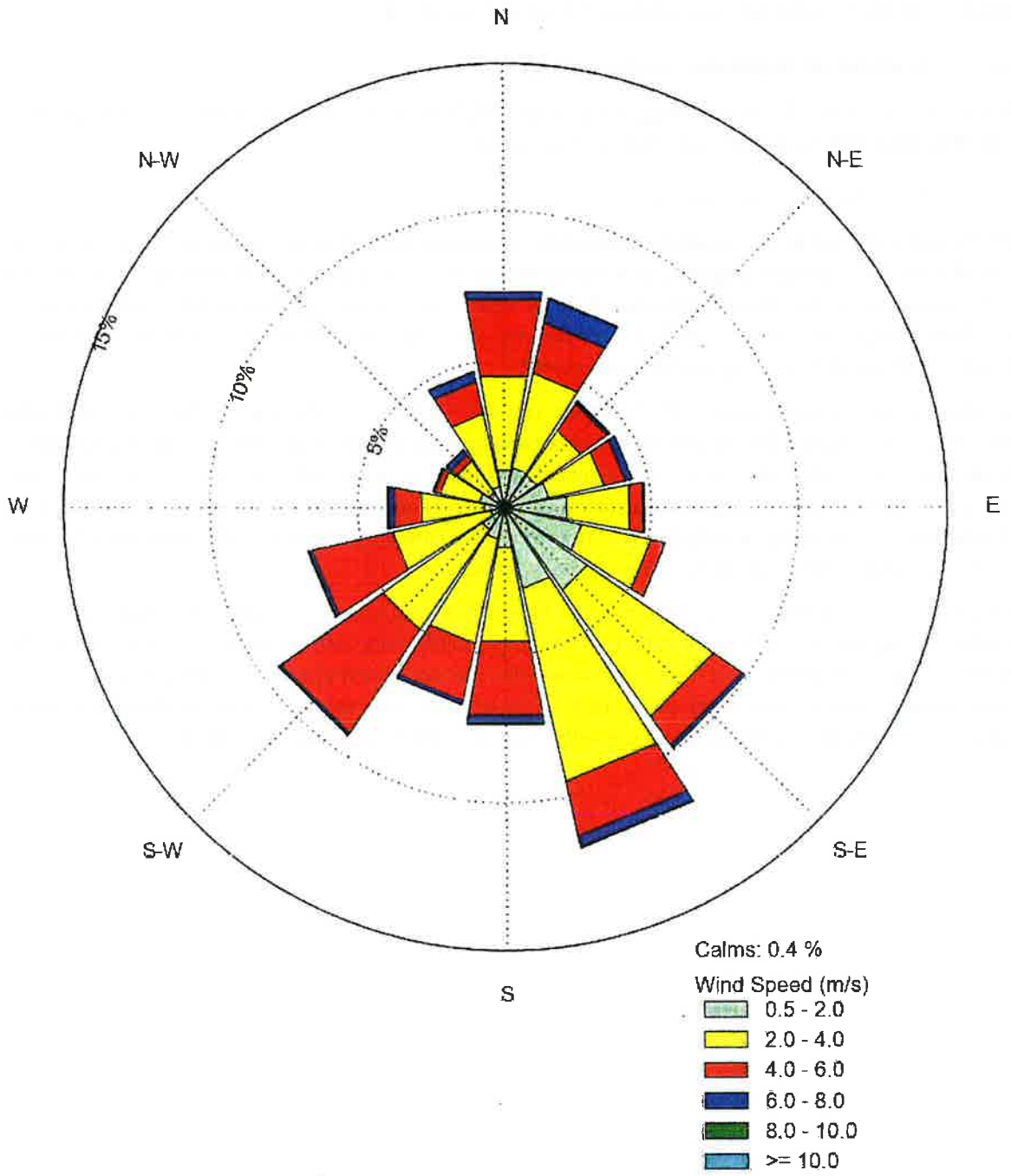


Figure 8-2 Annual distribution of winds at the site

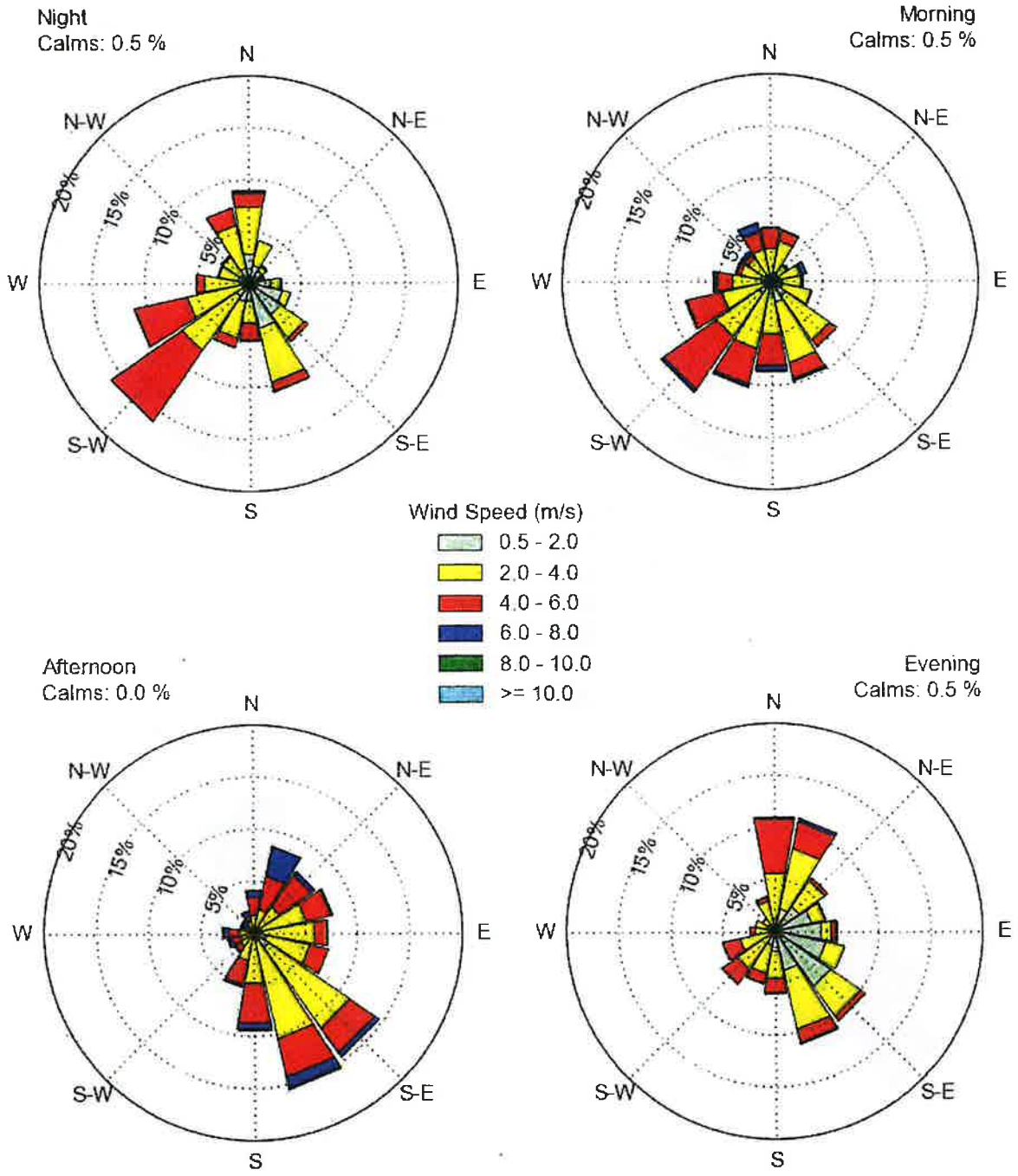


Figure 8-3 Diurnal distribution of winds at the site

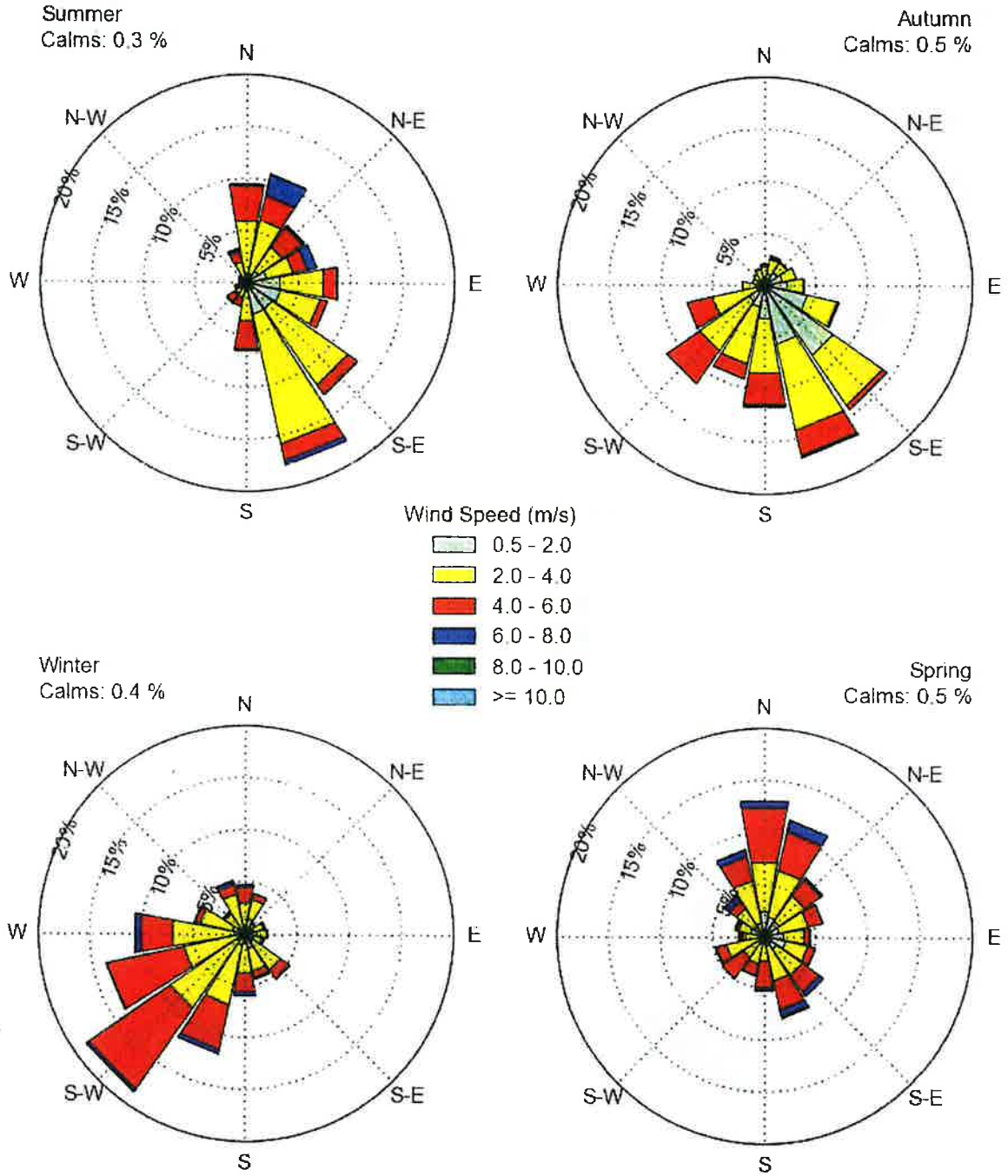


Figure 8-4 Seasonal distribution of winds at the site

The mean annual, seasonal and diurnal wind speeds and proportion of calms are presented in Table 8-1.

Table 8-1 Annual, seasonal and diurnal mean wind speeds

Period	Mean Wind Speed (m/s)	Calms (%)
Annual	3.2	0.4
Summer	3.2	0.3
Autumn	2.6	0.5
Winter	3.4	0.4
Spring	3.4	0.5
Night: Midnight to 6am	2.8	0.6
Morning: 6am to Midday	3.3	0.6
Afternoon: Midday to 6pm	3.8	0.1
Evening: 6pm to midnight	2.7	0.6

The modelled profiles of wind speed and direction have also been presented graphically as heat maps in Figure 8-5, to illustrate the monthly and hourly trends in wind conditions.

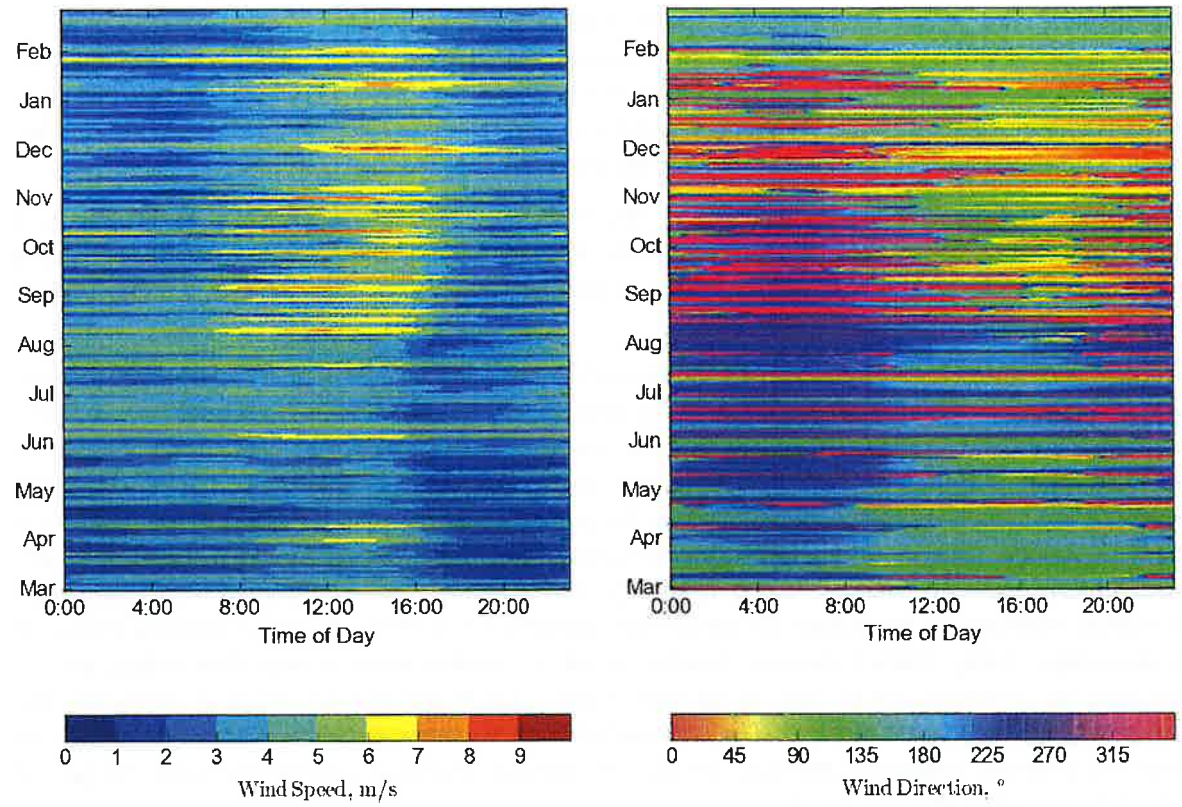


Figure 8-5 Predicted monthly and hourly profiles of wind speed and direction at the site

8.4.2 Atmospheric stability and mixing height

The flow of air in the planetary boundary layer (lowest one kilometre of the atmosphere) is an important factor in the dispersion of air pollutants and their effect on the population. This flow is affected by turbulence, which in turn affects the dispersion of the plume. Turbulence describes the vertical and horizontal motion of air and how a plume may be spread out and diffused. As turbulence increases, so does the rate of plume diffusion. As turbulence decreases, this diffusion is limited resulting in higher pollutant concentrations in the plume.

Turbulence is driven by thermal and mechanical influences as the atmosphere interacts with the land surface. Thermally driven turbulence is generated by convection as the sun heats the ground and the air above it is warmed, causing it to rise. Mechanically driven turbulence is generated by frictional effects as wind passes over the surface or by wind shear, produced at the boundary of two coinciding layers of wind or two different air masses.

A key indicator of thermally driven turbulence (or convection) in the atmosphere is stability, which is measured by the environmental lapse rate or vertical temperature profile of the atmosphere. Stability is a term applied to the properties of the atmosphere that govern the acceleration of the vertical motion of an air parcel. The acceleration is positive in an unstable atmosphere (turbulence increases), zero when the atmosphere is neutral, and negative (deceleration) when the atmosphere is stable (turbulence is suppressed). The vertical temperature gradient in the atmosphere governs whether a parcel of air, or plume, released into it will rise, fall, disperse or remain relatively still. If the plume is warmer than the surrounding air, it will tend to rise, while a plume that is cooler than the atmosphere will sink. Wind, or horizontal air movement, affects mechanical turbulence and therefore also affects atmospheric stability. As the wind speed increases, atmospheric stability will tend toward neutral conditions.

Atmospheric stability is commonly defined in terms of six main stability classifications designated as A (highly unstable or convective), B (moderately unstable), C (slightly unstable), D (neutral), E (slightly stable) and F (stable). This is known as the Pasquill-Gifford stability classification and is widely used to describe the turbulent state of the atmosphere.

Unstable conditions (Classes A-C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground, and usually results in material from a plume reaching the ground closer to the source than for neutral or stable conditions. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for neutral conditions (Class D) are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface, such as terrain features and building structures. During the night, the atmospheric conditions are neutral or stable (Class D, E and F). During stable conditions, plumes from short stacks or fugitive releases will be subject to minimal atmospheric turbulence. A plume released below an inversion layer during stable conditions, that has insufficient vertical momentum or thermal buoyancy to penetrate the inversion, will be trapped beneath it and result in elevated ground-level concentrations. Conversely, a plume that is hotter than its surroundings and is emitted above, or is able to penetrate the nocturnal inversion through momentum, will remain relatively undiluted, and will not reach the ground unless it encounters elevated terrain.

The frequencies of Pasquill-Gifford stability classes based on the CALMET model predictions are presented in Figure 8-6. The distribution of Pasquill-Gifford stability classes by hour of day is illustrated in Figure 8-7.

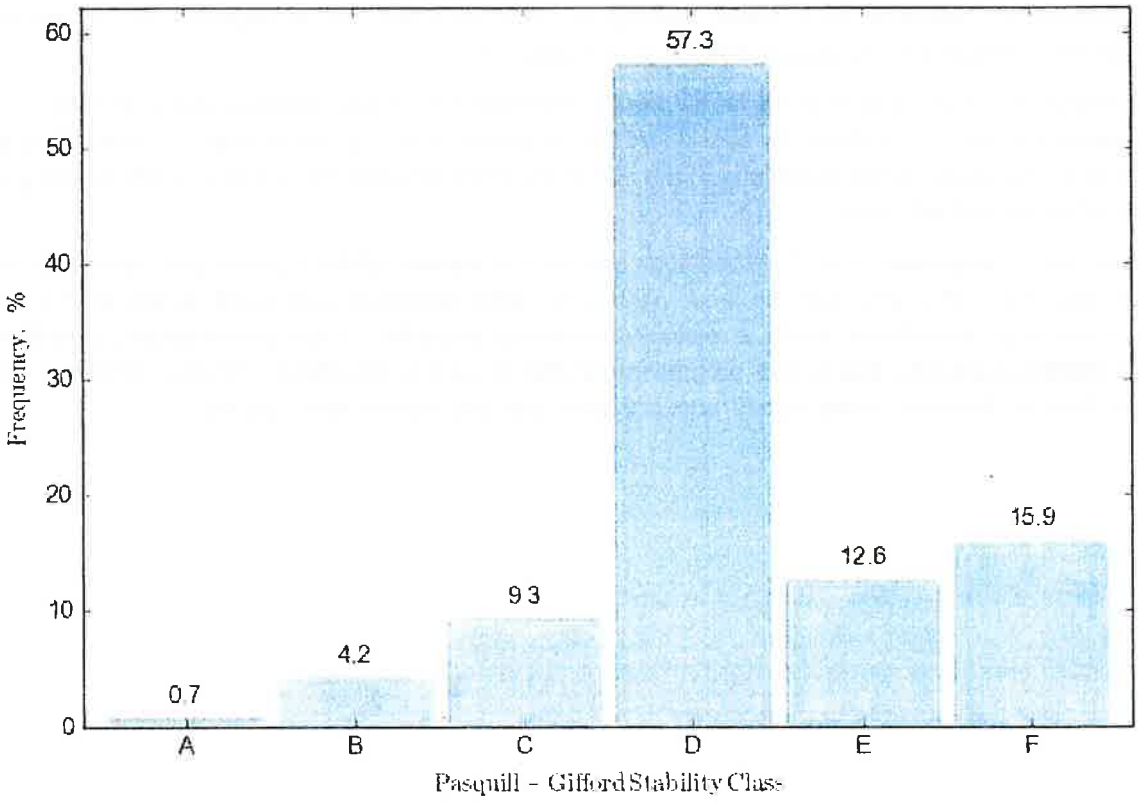


Figure 8-6 Frequency distribution of hourly atmospheric stability classifications at the site

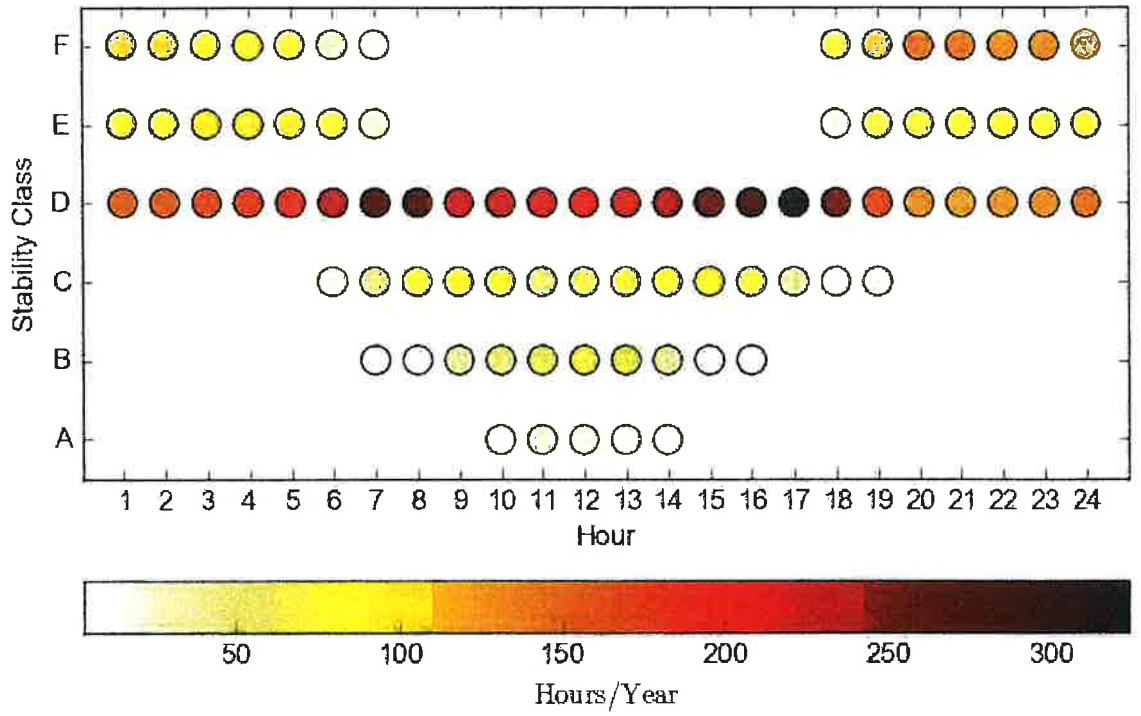


Figure 8-7 Distribution of hourly atmospheric stability

The relationship between atmospheric stability and the wind direction is explored as the annual distribution in Figure 8-8 and diurnal distribution in Figure 8-9.

All of the air emission sources at the facility are considered to be fugitive volume or wake affected point sources in the model. It is generally considered that dispersion from fugitive and wake affected sources is most problematical during conditions with a stable to neutral atmosphere and light winds resulting in minimal mixing and diffusion.

The significant proportion of neutral conditions predicted at the site (51%) is primarily considered to be a function of the wind speeds in the area. With mean wind speeds at night being greater than 2 m/s and a low proportion of calm winds, a relatively low annual proportion of stable atmospheric conditions were predicted (28.5%) and a high proportion (57.3%) of neutral conditions. Stable conditions can arrive from all directions, being slightly more prevalent from the four northerly sectors.

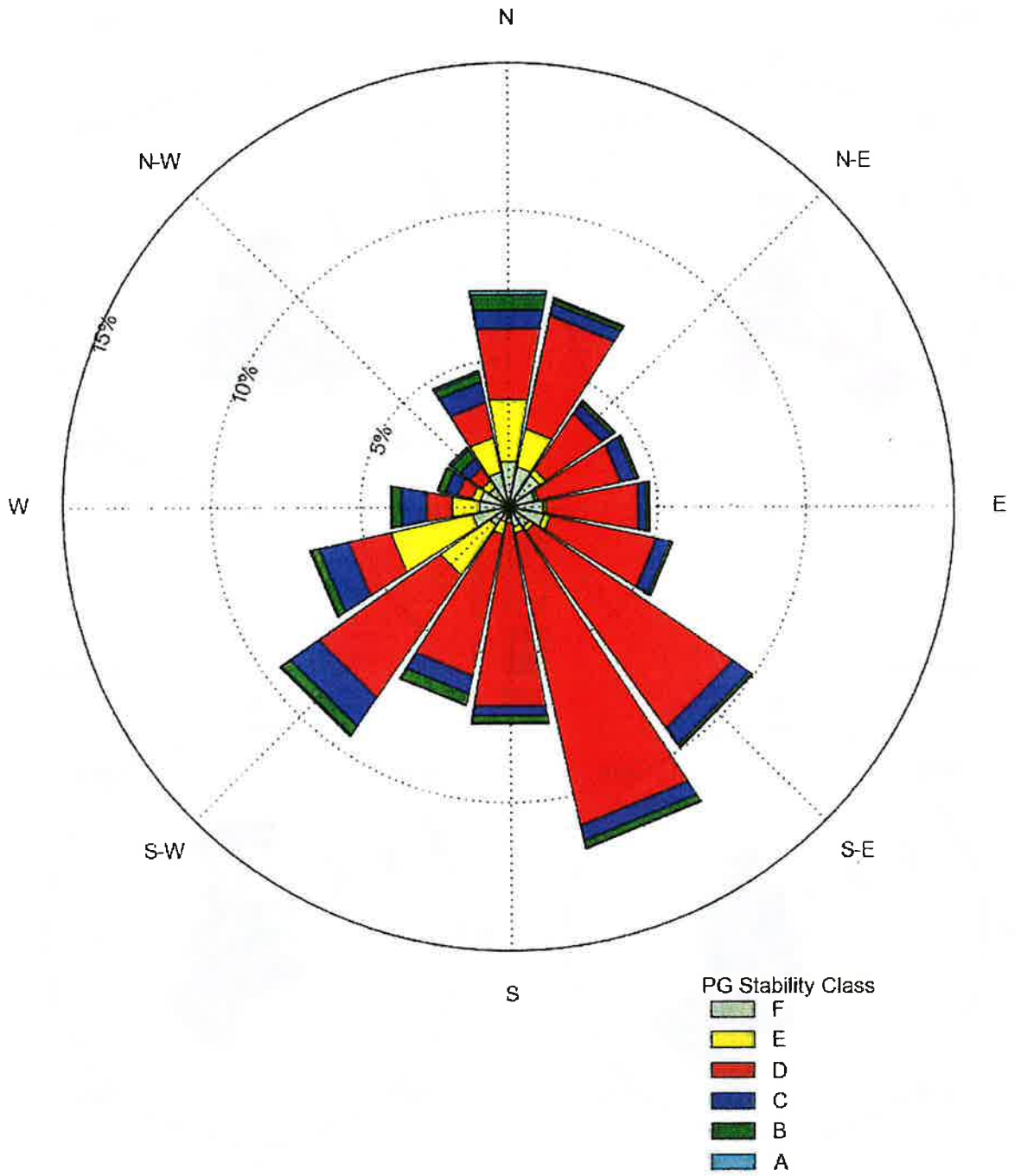


Figure 8-8 Stability classification rose diagram illustrating the relationship between hourly wind direction and Pasquill-Gifford stability class

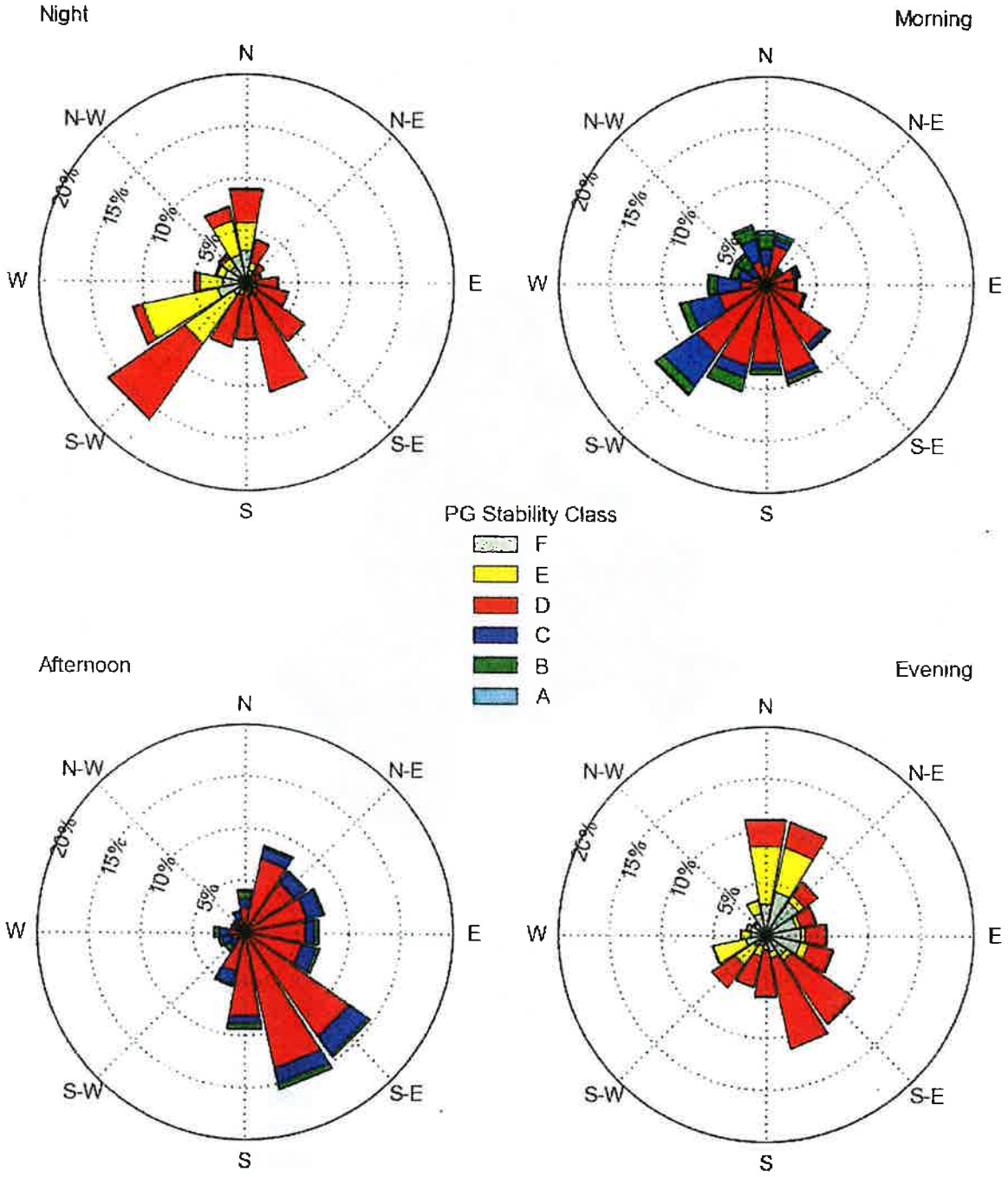


Figure 8-9 **Stability classification rose diagram illustrating the relationship between hourly wind direction and Pasquill-Gifford stability class**

The mixing height refers to the height above ground within which the plume can mix with ambient air. During stable atmospheric conditions at night, the mixing height is often quite low. During the day, incoming short wave solar radiation from the sun heats the ground, which in turn re-radiates long wave radiation back into the atmosphere, heating the air above it. The heating of the air near the ground generates the growth of convection cells causing the air, and hence the mixing height, to rise. The air above the mixing height during the day is generally cooler. The growth of the mixing height is dependent on how well the air can mix with the cooler upper levels of air and therefore depends on turbulence, i.e. meteorological factors such as the intensity of solar radiation and wind speed. During strong wind speed conditions the air will be well mixed, resulting in a high mixing height.

The hourly distributions of mixing height at the site from the CALMET model are presented as a box and whisker plot in Figure 8-10.

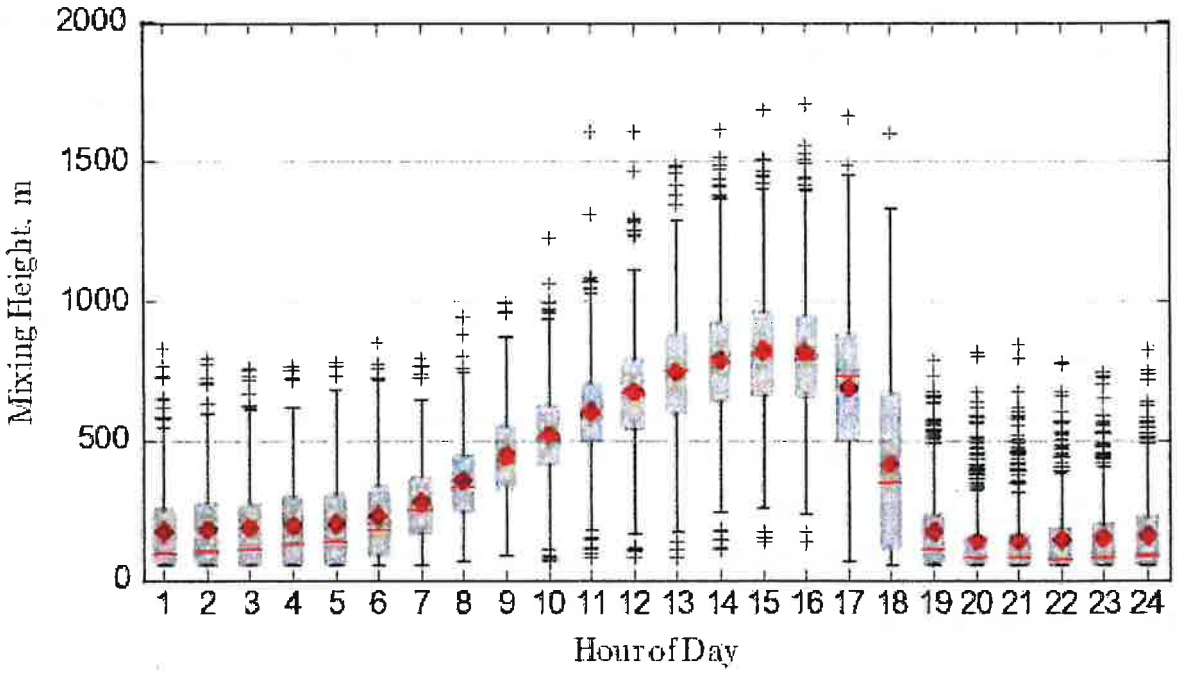


Figure 8-10 Distribution of hourly mixing heights at the site

8.5 Dispersion modelling

Source characteristics and pollutant emission rates were incorporated into the CALPUFF dispersion model. The CALPUFF model (version 7.2.1) is a standard regulatory model developed by Earth Tech in the United States.

CALPUFF is an advanced non-steady-state air quality modelling system. Twelve months of modelled meteorological data, generated from the TAPM/CALMET modelling system, was used as input for the dispersion model in order to include all weather conditions likely to be experienced in the region during a typical year. The modelling has been used to predict maximum ground-level concentrations of air pollutants across a Cartesian grid. Ground-level odour concentrations at sensitive receivers have been determined from the predicted concentrations in the grid cell in which the receiver is located.

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentrations and deposition rates across a network of receptors spaced at regular intervals and at identified discrete locations. CALPUFF is a non-steady-state Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, and wet and dry removal. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF takes into account the geophysical features of the study area that affects dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

The model was configured following recommended settings defined in the NSW Modelling Guidance document (OEH, 2011). Key features of CALPUFF used to simulate dispersion:

- Domain area of 229 by 229 grids at 50 m spacing corresponding to the CALMET domain,
- 365 days modelled corresponding to the CALMET modelling period,
- Gridded 3D hourly-varying meteorological conditions generated by CALMET,
- Partial plume path adjustment for terrain modelled,
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables,
- CALPUFF parameters set based on recommendations from the Generic Guidance and Optimum Model Settings for CALPUFF, and
- All other options set to default.

An example of the CALPUFF model input file is presented in Appendix D.

8.6 Model receptors

8.6.1 Grid receptors

The CALMET meteorological model was configured for terrain and land use features on a Cartesian grid at a resolution of 100 m by 100 m. This provides for the prediction of the full suite of meteorological variables at a resolution of 100 m. The CALPUFF dispersion model was then configured to predict ground-level pollutant concentrations using grid receptors at the domain resolution equivalent to the CALMET domain (i.e. 100 m by 100 m).

8.6.2 Discrete receptors

The residential zones in the Alstonville area plus nine more isolated locations have been identified as sensitive receivers in the local area surrounding the asphalt plant. The Alstonville Asphalt Facility's site boundary, main stack and the location of nearby sensitive receptors are illustrated in Figure 8-11. The discrete receptor locations were not input into the model rather results for each receptor have been extracted from the model's gridded results based on the 100 m by 100 m (i.e. 1 ha) grid resolution.

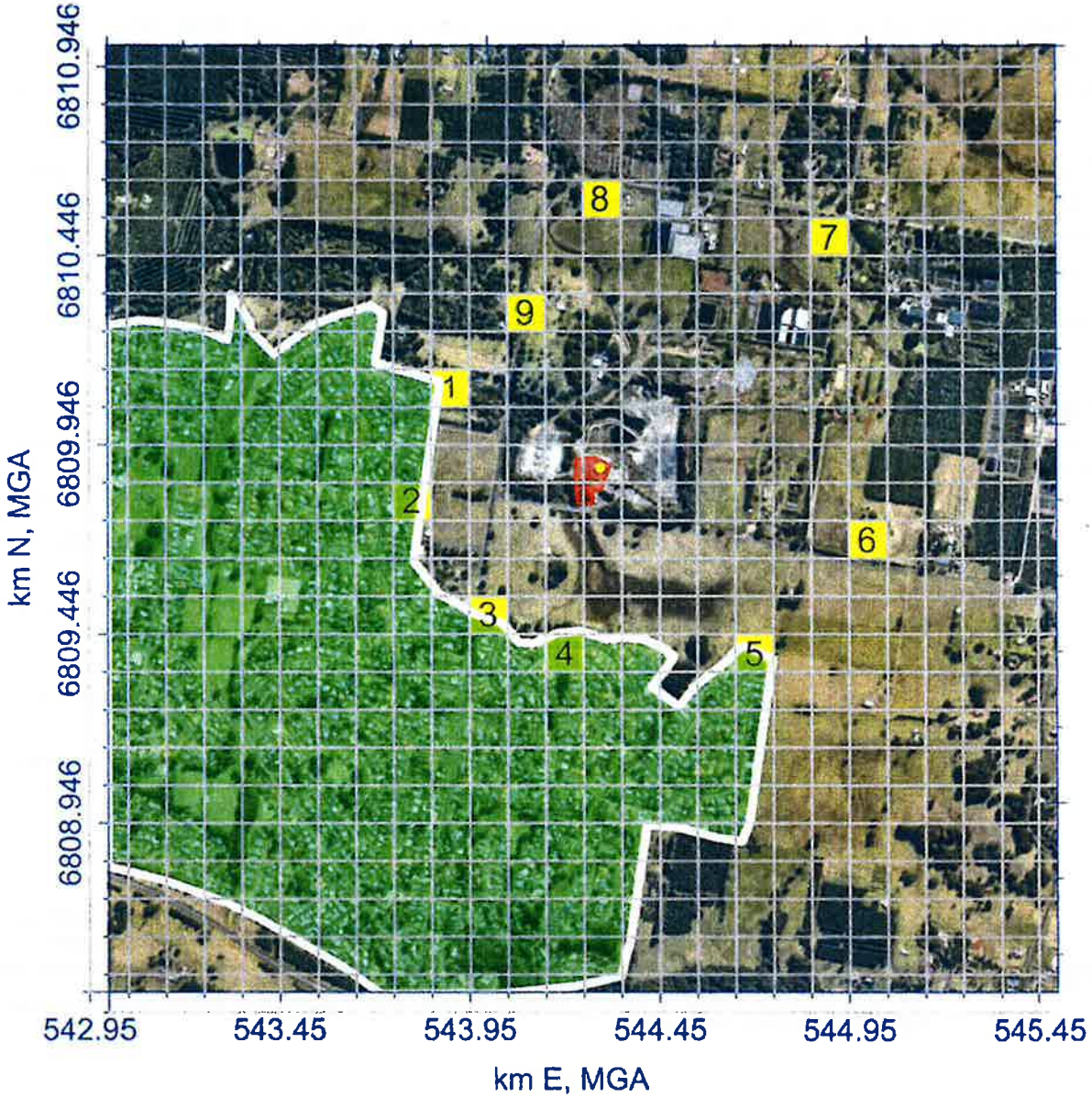


Figure 8-11 CALPUFF grid cells and nearest sensitive receivers

Figure note: Plant location and site boundary = red shaded area
Dryer Kiln stack = yellow dot
Alstonville residential zones = green shaded area with white border
Isolated sensitive receiver locations= numbered yellow square cells

8.7 Assessment scenarios

The assessment has been made with a series of dispersion model scenarios that investigate:

- All sources combined,
- The combined fugitive asphalt mix emissions including a Bitumen Tank during filling, and
- The Dryer Kiln stack, in isolation.

Scenario 1 (All Odour Sources Combined) has been assessed against the NSW odour impact assessment criterion of 2 OU, for a 1-second averaging period at the 99.0th percentile (88th highest hour) statistic. The contributions of the main stack and fugitive asphalt sources have also been assessed against this criterion.

The predicted maximum (100th percentile) ground-level odour concentrations have also been investigated to understand the highest potential instantaneous (1-second averaging period) exposure to odour in the area based on odour emissions on the day of sampling and the worst case meteorological conditions throughout an entire year.

The assessment scenarios are summarised in Table 8-2.

Table 8-2 Odour assessment scenarios

Scenario	Emissions scenario	Emission sources	Percentile statistic
1	All odour sources combined	Fugitive asphalt mix including Bitumen Tank during filling and Dryer Kiln stack	99.0th %ile for compliance 100th %ile to assess maximum instantaneous exposure
2	Fugitive asphalt mix	Skip conveyor during loading, Skip Conveyor in transit, Hot Asphalt Storage Bins and bins during loading, Truck loading, loaded truck in load out area, loaded truck on weighbridge, and Bitumen Tank during filling	99.0th %ile for compliance 100th %ile to assess maximum instantaneous exposure
3	Main stack	Dryer Kiln only	99.0th %ile for compliance 100th %ile to assess maximum instantaneous exposure

Table note: The NSW odour impact assessment criterion is represented by the 99.0th percentile statistic.
The 100th percentile statistic or highest 1-second average nose response time represents the predicted highest instantaneous odour exposure.

9 Impact Assessment

9.1 Compliance with NSW odour assessment criterion

9.1.1 All sources combined

To assess the Alstonville Asphalt Plant's compliance with the NSW odour impact assessment criterion, cumulative ground-level odour concentrations have been predicted across a Cartesian grid domain for all emission sources combined based on the assumption that the facility operates on a continuous basis during all hours of the year. The predicted 99.0th percentile, 1-second average cumulative ground-level odour concentrations are presented in Figure 9-1. This reflects the plant's operations under its environmental protection license conditions however, in reality the batch plant operates intermittently and with a highly variable rate of production.

As described in Section 8.6, the concentration contour isopleths and concentrations at sensitive receptors are based on model predictions on a 1 ha (100 m by 100 m) grid area resolution. Consequently, predictions at sensitive receivers are representative of the concentrations predicted for that entire cell. The predicted 99.0th percentile, 1-second average cumulative ground-level odour concentrations at each sensitive area are presented in Table 9-1. Predicted ground-level odour concentrations comply with the EPA's 2 OU criterion at all sensitive receptor locations.

Table 9-1 Predicted 99.0th percentile, 1-second average ground-level odour concentrations at sensitive receiver locations for all sources combined in continuous operation

Sensitive receiver location		Predicted 99.0th percentile, 1-second average ground-level odour concentration (OU)
Maximum within residential zones		1.6
Maximum at isolated sensitive receivers	R1	1.9
	R2	1.5
	R3	1.4
	R4	1.4
	R5	0.7
	R6	0.6
	R7	1.2
	R8	0.6
	R9	1.6

Table note: The NSW odour impact assessment criterion level is 2 OU.
Sensitive receiver areas are illustrated in map in Figure 8-11.

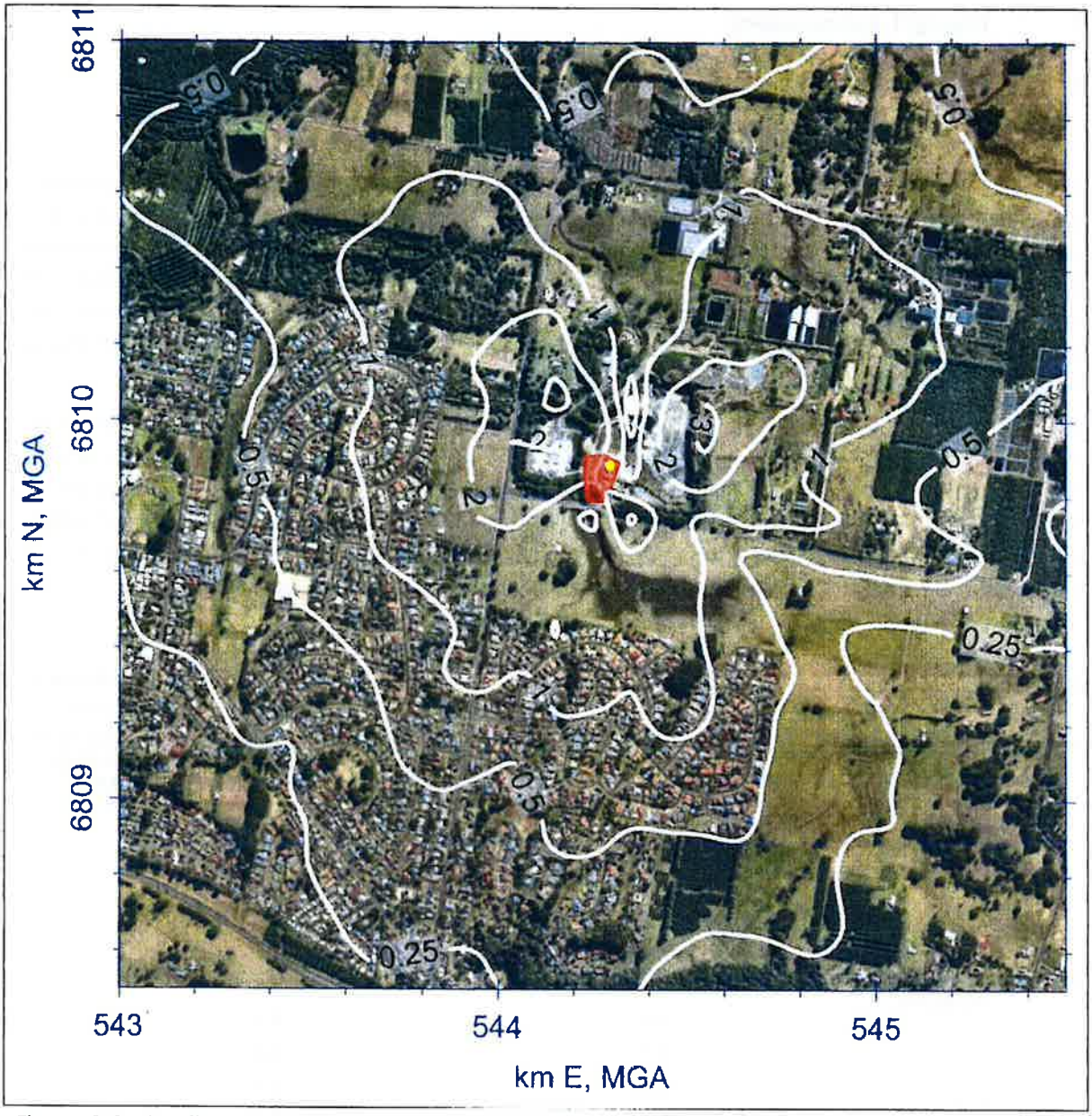


Figure 9-1 Predicted 99.0th percentile cumulative 1-second average ground-level odour concentrations associated with all sources

Assessment scenario: All fugitive and Dryer Kiln stack emissions combined during all hours of the year

Units: OU

Contours: Predicted 99.0th percentile 1-second average ground-level odour concentrations

Assessment criterion: 2 OU

Data source: CALPUFF

Prepared by: M. Power

Location: Alstonville Asphalt Plant, Alstonville, NSW

Date: 26 September 2017

Figure note: The red shaded area represents the Alstonville Asphalt Plant site area and boundary. The yellow dot represent the Dryer Kiln Stack location.

9.1.2 Contribution of fugitive asphalt mix and Dryer Kiln stack emissions

To investigate the individual source contributions to ground-level odour concentrations the combined fugitive asphalt production and Dryer Kiln stack emissions were modelled and assessed separately. The predicted 99.0th percentile, 1-second average ground-level odour concentrations for the fugitive asphalt and Dryer Kiln stack emissions are presented in Figure 9-2 and Figure 9-3. Predicted ground-level odour concentrations at sensitive receivers are presented in Table 9-2.

Table 9-2 Predicted 99.0th percentile, 1-second average ground-level odour concentrations at sensitive receiver locations for fugitive asphalt mix sources and the main stack, in continuous operation

Sensitive receiver location		Predicted 99.0th percentile, 1-second average ground-level odour concentration (OU)	
		All fugitive asphalt mix emission sources combined	Dryer Kiln Stack in isolation
Maximum within residential zones		0.014	1.5
Maximum at isolated sensitive receivers	R1	0.018	1.9
	R2	0.006	1.5
	R3	0.010	1.4
	R4	0.013	1.4
	R5	0.003	0.7
	R6	0.002	0.6
	R7	0.004	1.2
	R8	0.004	0.6
	R9	0.012	1.6

Table note: The NSW odour impact assessment criterion level is 2 OU.
Sensitive receiver areas are illustrated in map in Figure 8-11.

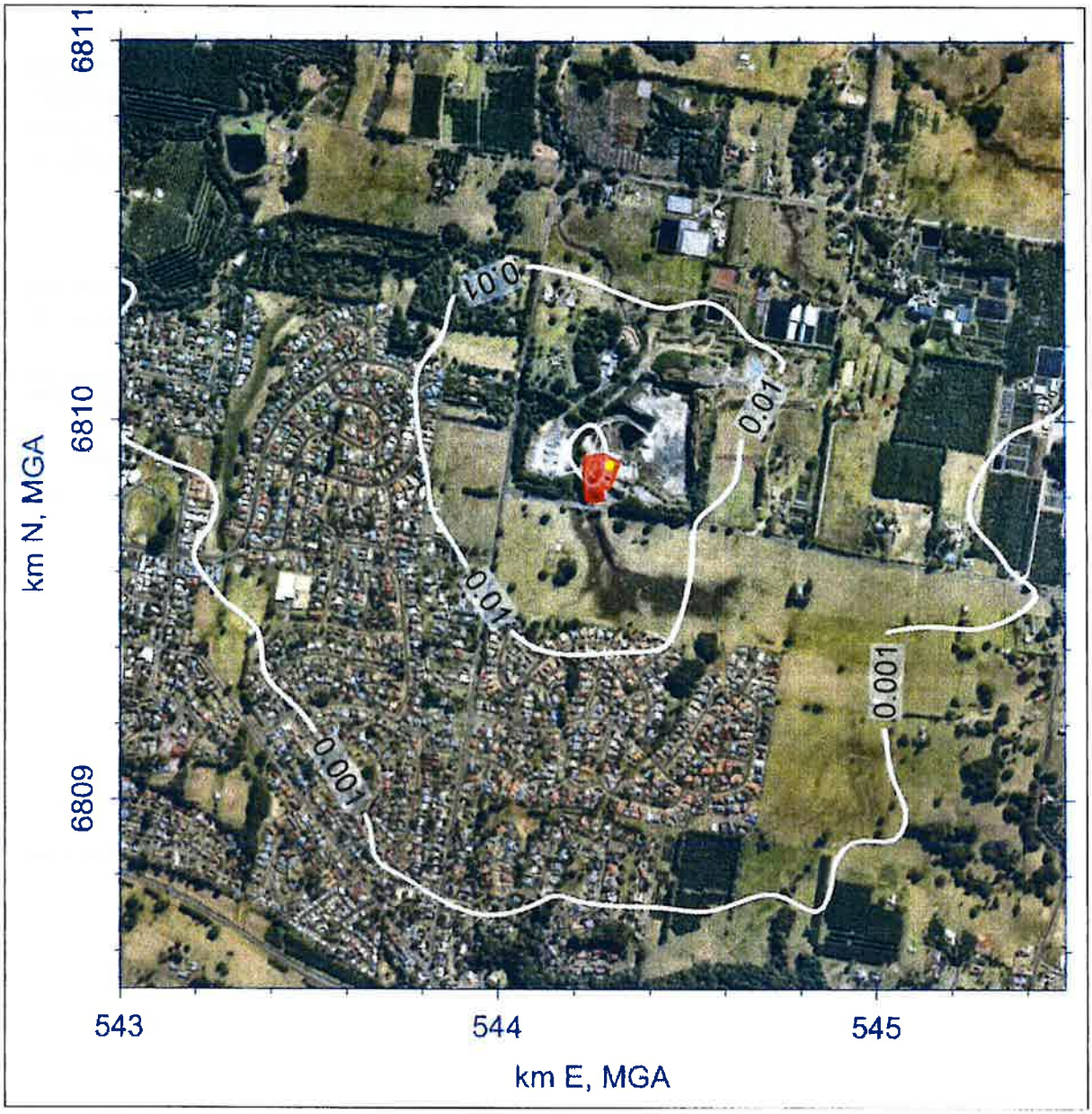


Figure 9-2 Predicted 99.0th percentile 1-second average ground-level odour concentrations associated with all fugitive asphalt mix sources including Bitumen Tank during filling

Assessment scenario: All fugitive asphalt mix sources and Bitumen tank during filling emissions combined during all hours of the year	**Units:** OU
Contours: Predicted 99.0th percentile 1-second average ground-level odour concentrations	**Assessment criterion:** 2 OU
Data source: CALPUFF	**Prepared by:** M. Power
Location: Alstonville Asphalt Plant, Alstonville, NSW	**Date:** 26 September 2017

Figure note: The red shaded area represents the Alstonville Asphalt Plant site area and boundary. The yellow dot represent the Dryer Kiln Stack location.

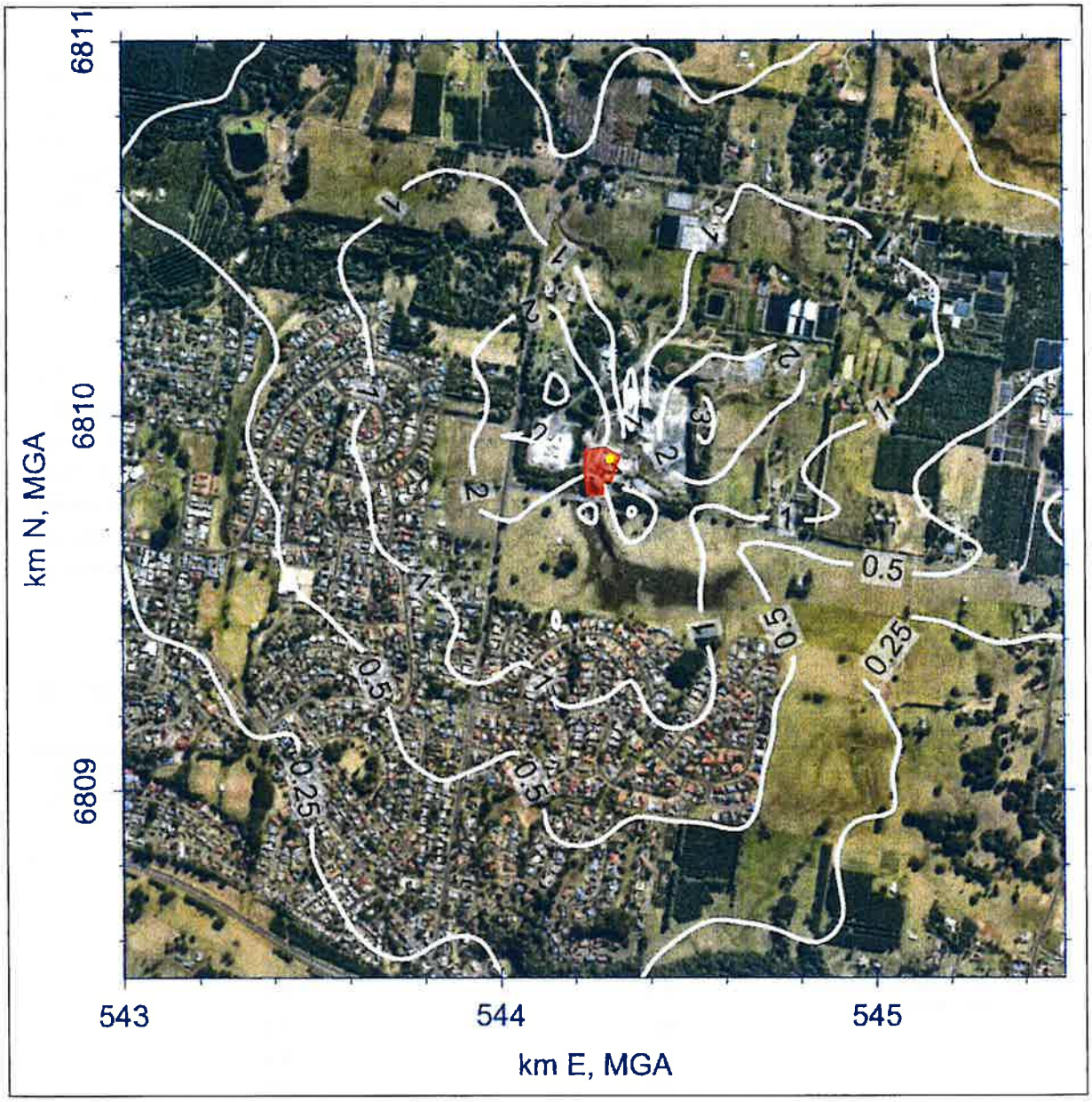


Figure 9-3 Predicted 99.0th percentile 1-second average ground-level odour concentrations for the Dryer Kiln stack in isolation

Assessment scenario: Dryer Kiln stack emissions during all hours of the year

Units: OU

Contours: Predicted 99.0th percentile 1-second average ground-level odour concentrations

Assessment criterion: 2 OU

Data source: CALPUFF

Prepared by: M. Power

Location: Alstonville Asphalt Plant, Alstonville, NSW

Date: 26 September 2017

Figure note: The red shaded area represents the Alstonville Asphalt Plant site area and boundary. The yellow dot represent the Dryer Kiln Stack location.

9.2 Predicted peak odour exposure

As described in Section 5.3, the NSW odour policy framework aims to *protect the environment and community from the impacts of odour emissions while promoting fair and equitable outcomes for the operators of activities that emit odour* (DEC, 2006). Whilst there is a legal obligation for an odour generating activity to prevent odorous air emissions from its activities impacting the local community, no odour at all is not a realistic objective and nearby sensitive receivers may experience odours from time to time. Consequently, based on the probability of odour impacts causing complaints from local communities, the assessment criterion was set at the 2 OU concentration level for the 99.0th percentile, or 88th highest hour. The assessment, as presented in Section 9.1, determined that the Alstonville asphalt plant was in compliance with the odour criterion.

Notwithstanding this compliance with the odour criterion, Air Environment Consulting understands that Ballina Shire Council has routinely received complaints from the community about annoyance from odour emissions generated by the asphalt plant. To understand the potential conditions under which odour may be experienced in the community, further dispersion modelling investigations were conducted to investigate the highest odour concentrations. The predicted maximum (100th percentile statistic) ground-level odour concentrations for the three scenarios modelled are presented as concentration isopleths in Figure 9-4 to Figure 9-6. Predicted ground-level odour concentrations at sensitive receivers are presented in Table 9-3 and Table 9-4.

Table 9-3 Predicted highest 1-second average ground-level odour concentrations at sensitive receiver locations for all sources combined in continuous operation

Sensitive receiver location		Predicted highest (100th percentile) 1-second average ground-level odour concentration (OU)
Maximum within residential zones		3.2
Maximum at isolated sensitive receivers	R1	2.8
	R2	3.2
	R3	2.4
	R4	2.2
	R5	2.4
	R6	3.5
	R7	2.4
	R8	0.9
	R9	2.2

Table note: The NSW odour impact assessment criterion does not apply to the 100th percentile statistic.
Sensitive receiver areas are illustrated in map in Figure 8-11.

Table 9-4 Predicted highest 1-second average ground-level odour concentrations for fugitive asphalt mix sources and the main stack, in continuous operation

Sensitive receiver location		Predicted highest (100th percentile) 1-second average ground-level odour concentration (OU)	
		All fugitive asphalt mix emission sources combined	Dryer Kiln Stack in isolation
Maximum within residential zones		0.2	3.2
Maximum at isolated sensitive receivers	R1	0.13	2.8
	R2	0.06	3.2
	R3	0.12	2.4
	R4	0.15	2.2
	R5	0.04	2.4
	R6	0.02	3.5
	R7	0.03	2.4
	R8	0.05	0.9
	R9	0.12	2.2

Table note: The NSW odour impact assessment criterion does not apply to the 100th percentile statistic. Sensitive receiver areas are illustrated in map in Figure 8-11.

The results indicate that predicted maximum ground-level odour concentrations associated with asphalt production and handling are well below the 2 OU concentration level. At receptor 4 to the south of the plant, predicted to be the area most affected by asphalt production and handling emissions, ground-level odour concentrations were predicted to be 13.3 times below the 2 OU concentration level and 6.7 times below the 1 OU odour detection threshold. This means the total combined asphalt production and handling emissions would need to be 6.7 times greater in order to be to be detected.

By comparison, predicted maximum ground-level odour concentrations associated with the main stack emissions were greater than the 2 OU concentration level at all sensitive receiver locations assessed with the exception of receptor 8. This result shows that while ground-level odour concentrations do not exceed the NSW odour assessment criterion, stack odour emissions may be detected in the community from time to time. The frequency of occurrence of odour experience is expected to be infrequent and at relatively low concentrations. Importantly, this finding is based on the asphalt plant operating during each hour of the year. Based on the Alstonville plant's operating data for the 2016-17 financial year, the batch plant only operated for 242.9 hours. This means that the probability of the plant operating during the worst case meteorological conditions likely to generate odour impact is very low.

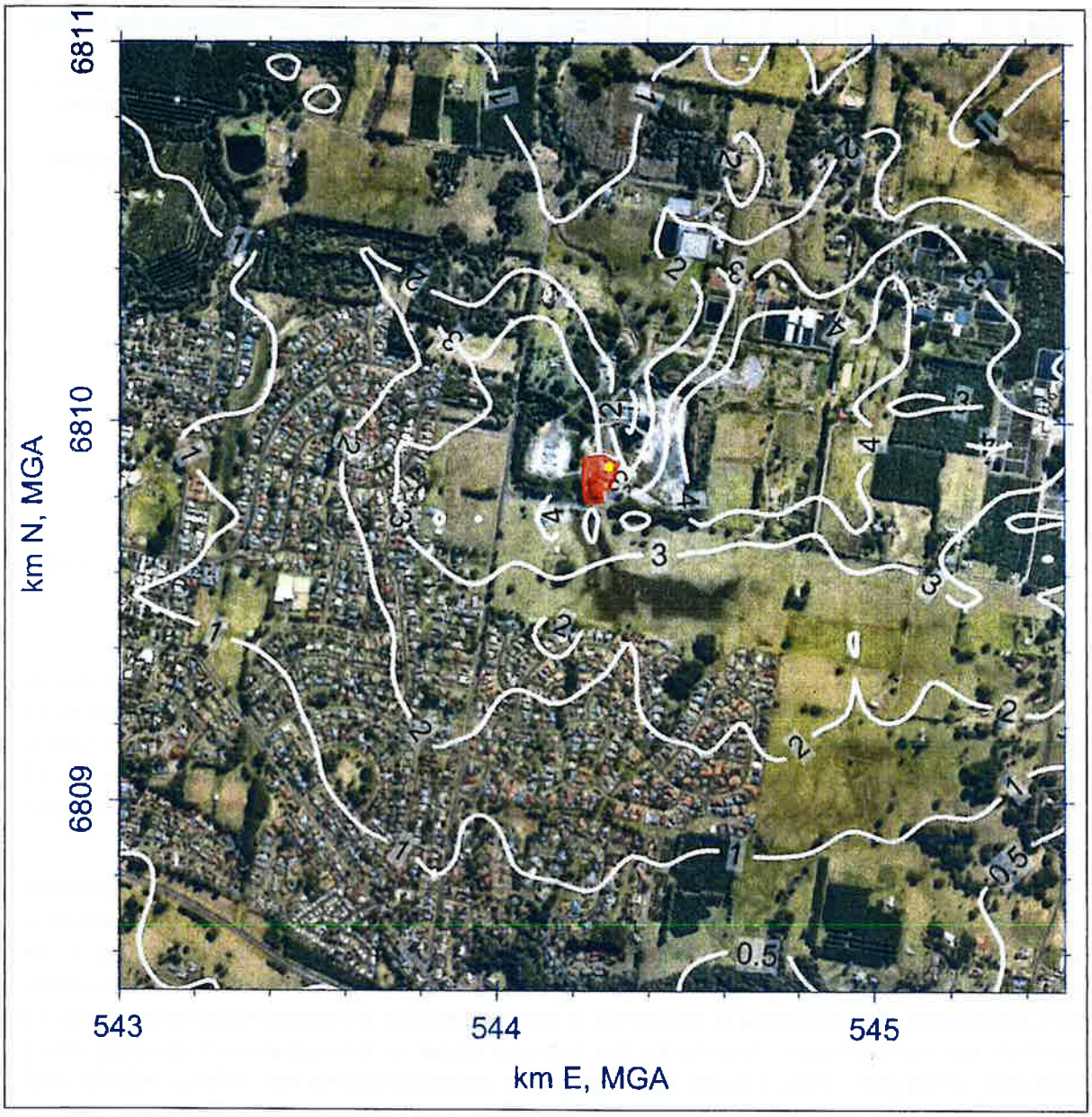


Figure 9-4 Predicted highest cumulative 1-second average ground-level odour concentrations associated with all sources

Assessment scenario: All fugitive and Dryer Kiln stack emissions combined during all hours of the year

Units: OU

Contours: Predicted 100th percentile 1-second average ground-level odour concentrations

Assessment criterion: 2 OU

Data source: CALPUFF

Prepared by: M. Power

Location: Alstonville Asphalt Plant, Alstonville, NSW

Date: 26 September 2017

Figure note: The red shaded area represents the Alstonville Asphalt Plant site area and boundary. The yellow dot represents the Dryer Kiln Stack location.

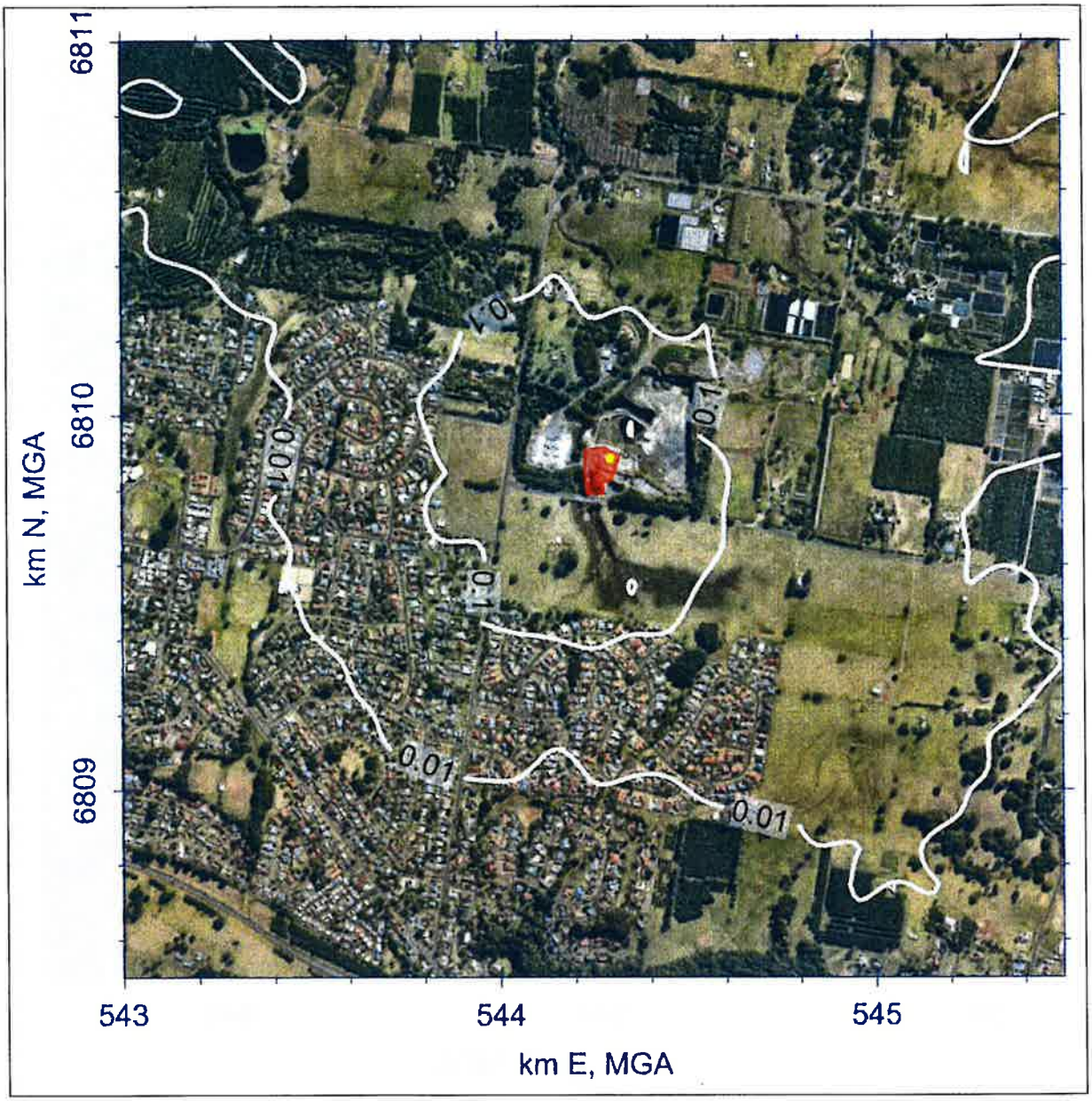


Figure 9-5 Predicted highest 1-second average ground-level odour concentrations associated with all fugitive asphalt mix sources including Bitumen Tank during filling

Assessment scenario: All fugitive asphalt mix sources and Bitumen tank during filling emissions combined during all hours of the year	**Units:** OU
Contours: Predicted 100th percentile 1-second average ground-level odour concentrations	**Assessment criterion:** 2 OU
Data source: CALPUFF	**Prepared by:** M. Power
Location: Alstonville Asphalt Plant, Alstonville, NSW	**Date:** 26 September 2017

Figure note: The red shaded area represents the Alstonville Asphalt Plant site area and boundary. The yellow dot represents the Dryer Kiln Stack location.

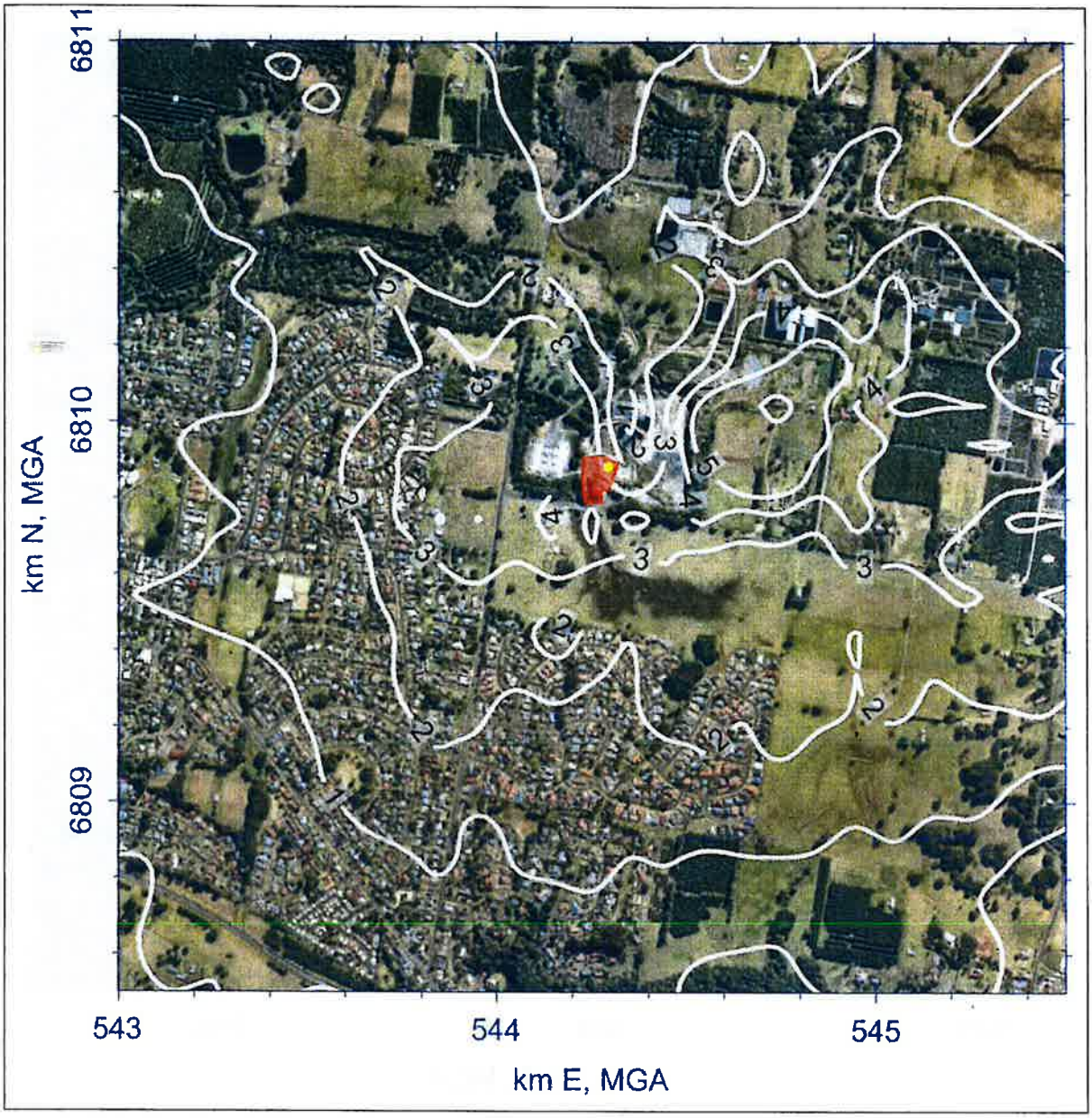


Figure 9-6 Predicted highest 1-second average ground-level odour concentrations for the Dryer Kiln stack in isolation

Assessment scenario: Dryer Kiln stack emissions during all hours of the year	**Units:** OU
Contours: Predicted 100th percentile 1-second average ground-level odour concentrations	**Assessment criterion:** 2 OU
Data source: CALPUFF	**Prepared by:** M. Power
Location: Alstonville Asphalt Plant, Alstonville, NSW	**Date:** 26 September 2017
Figure note:	The red shaded area represents the Alstonville Asphalt Plant site area and boundary. The yellow dot represents the Dryer Kiln Stack location.

10 Interpretation of Assessment Findings

The odour emissions inventory used in the impact assessment was based on site-specific odour emissions sampled and analysed using Australian standard methods prescribed by NSW EPA. The dispersion modelling assessment was also conducted in accordance with the EPA's Approved Methods and modelling guidance. Based on this approach, the assessment determined that odour impacts associated with air emissions from the Alstonville Asphalt Plant comply with the odour impact assessment criterion set by EPA at all sensitive locations.

The assessment has been made based on the asphalt plant operating in accordance with its license conditions, in that the facility has the capacity to operate continuously for every hour of the year. Consequently, the assessment has been made in consideration of all possible meteorological conditions including worst case plume dispersion conditions. All sources were also assumed to be in constant operation despite the fact that their emissions vary during any given operational hour. This assumption was made to ensure that the emission rates used within the model characterise the worst case situation within each hour when all source happen to be in peak operation simultaneously. This assessment is therefore considered to be extremely conservative as in reality the plant only operated for 242.9 hours out of the 8,760 hours in the year from 1 July 2016 to 30 June 2017. This equates to just 2.77% of the hours in the year.

An investigation of the contribution of various emission source types to total downwind odour impact determined that the most important source of odour was the main Dryer Kiln stack. Plume dispersion from the stack was determined to be affected by turbulence caused by wind flows around surrounding building structures that generate the effect of pulling the plume to ground level in the near field, while the location of the plant in the local terrain also influenced wind patterns and plume dispersion. A detailed analysis of the conditions under which odour impacts are most likely to occur is presented in the following sections.

10.1 Analysis of conditions under which impacts are predicted to occur

An analysis of the conditions under which odour impacts were predicted to occur was conducted based on the time of day and meteorological conditions. Predicted hourly odour concentration time series and corresponding meteorological data was extracted from grid cells situated around the plant, close to sensitive receiver areas. The grid cells selected for the analysis are illustrated in Figure 10-1.

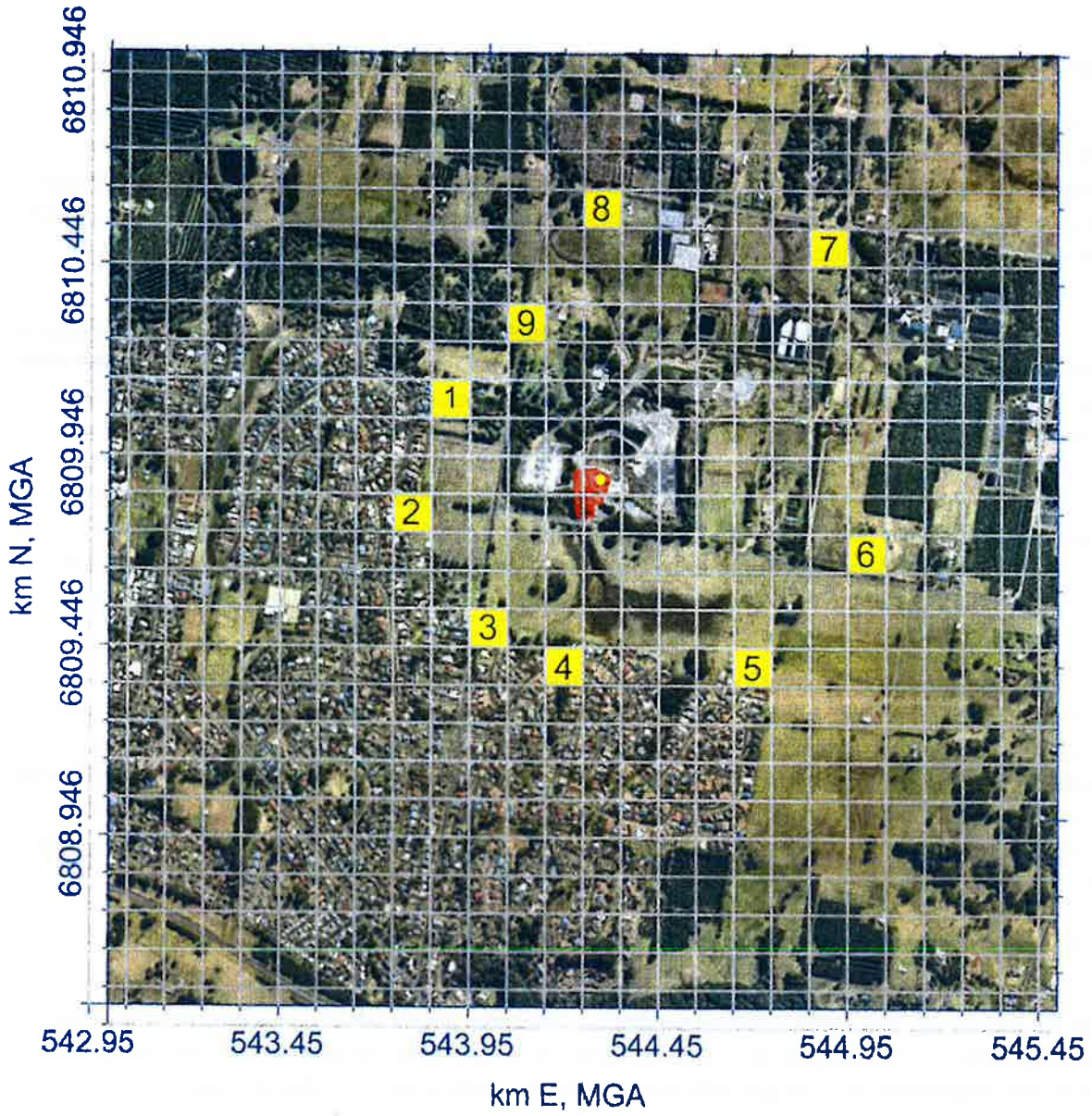


Figure 10-1 Location of grid cells extracted for analysis

10.1.1 Contribution of odour impact by source

The odour emissions inventory and dispersion modelling data both clearly show that odour emission associated with the main stack is the major contributor to ground-level odour concentrations in the local area. While this finding was consistent with observations made on the day where ambient odour on the site was low, the result is considered unusual for asphalt plants. In general, while fugitive emissions from asphalt production, storage and handling are highly variable throughout each hour, they are typically a greater contributor to total emissions and off site impacts than the stack.

Notwithstanding this, the odour emissions inventory on the day of sampling determined that the stack emissions were 20,444 OU/s compared to approximately 75 OU/s for the total asphalt production emissions combined, a factor difference of 273. At Location 1, the most affected sensitive receiver area based on fugitive asphalt emissions in isolation (at the criterion level, i.e. the 99th percentile), the

predicted 99.0th percentile ground-level odour concentration was 0.018 OU, a factor of 111 below the 2 OU criterion threshold.

To understand the stack odour emissions, a review of stack emissions monitoring data collected by AMG for the site's licensed annual compliance monitoring obligations was conducted. This data indicated that the primary odorous compounds reported in the stack emissions are nitrogen oxides and hydrogen sulfide. Concentrations of other odourous substances, such as sulfur dioxide, were found to be very low, while carbon monoxide was both low and is odourless. Dispersion modelling conducted by Air Environment Consulting on these substances found that all complied with their relevant air quality assessment criteria. Notwithstanding this, the odour associated with the combination of nitrogen oxides and hydrogen sulfide, even at levels below their assessment criteria, may be detectable in the ambient environment downwind of the site.

The character of the stack odour emission was described in the AMG odour emissions report as 'slight chlorine' and 'moist soil'. However, after further email correspondence with the testing laboratory, it was suggested that during the odour testing, *"the stack emissions could be said to be mixed with a combustion smell (slight NO_X odour), but still overwhelmingly asphalt"* (pers. comm, David Arbuckle, 3/08/17). This asphalt character from the stack plume may go some way to explain the odour complaints received from the local community. Notwithstanding this, the result is curious as there is no direct process or air flow connection between the kiln emissions ducted to the stack and the application of bitumen to the aggregate from the kiln when in the Pug Mill to produced asphalt mix.

10.1.2 Relationship between odour concentration and intensity

The odour emissions survey determined that there was little practical difference in the surface emission rate or OCI relationships of asphalt produced at 165°C and 185°C. Similarly, the difference in stack odour emission rates for the two production temperatures were also within the margin of expected variability for olfactometric measurement.

The OCI relationship analysis, however, does show that bitumen tank odour emissions are significantly more intense than the emissions from the asphalt product surface, while the intensity of the asphalt product is significantly more intense than the stack emissions. This means that, at the NSW criterion level of 2 OU:

- Stack emissions were considered to have an intensity rank of approximately 1.25 (i.e. slightly higher than very weak),
- Asphalt product emissions were considered to have an intensity rank of approximately 1.75 (i.e. slightly less than weak), and
- Bitumen tank emissions were considered to have an intensity rank of approximately 3.5 (i.e. between distinct [or moderate] and strong).

Put another way, distinct intensity odour, that may be considered to cause nuisance in the community, was able to be perceived for the:

- Stack emissions at 9.3 OU,
- Asphalt product emissions at between 4.8 and 5.3 OU, and
- Bitumen tank emissions at approximately 1.4 OU.

Notwithstanding these findings, odour concentrations from these sources were predicted well below these thresholds.

10.1.3 Predicted odour impacts by season and hour of the day for all sources

Cumulative ground-level odour concentrations associated with the Dryer Kiln stack and fugitive asphalt emissions have been analysed at nine sensitive locations surrounding the plant based on their impact by season and hour of day. This analysis comprises a series of heat maps (Figure 10-2 to Figure 10-4) illustrating ground-level odour concentrations by hour of day and day of the year, and box and whisker plots (Figure 10-5 to Figure 10-6) showing the distribution of odour concentrations by hour of day. The frequency of ground-level odour concentrations greater than two odour units at each sensitive receptor cell by hour of day is illustrated as a frequency distribution histogram in Figure 10-7.

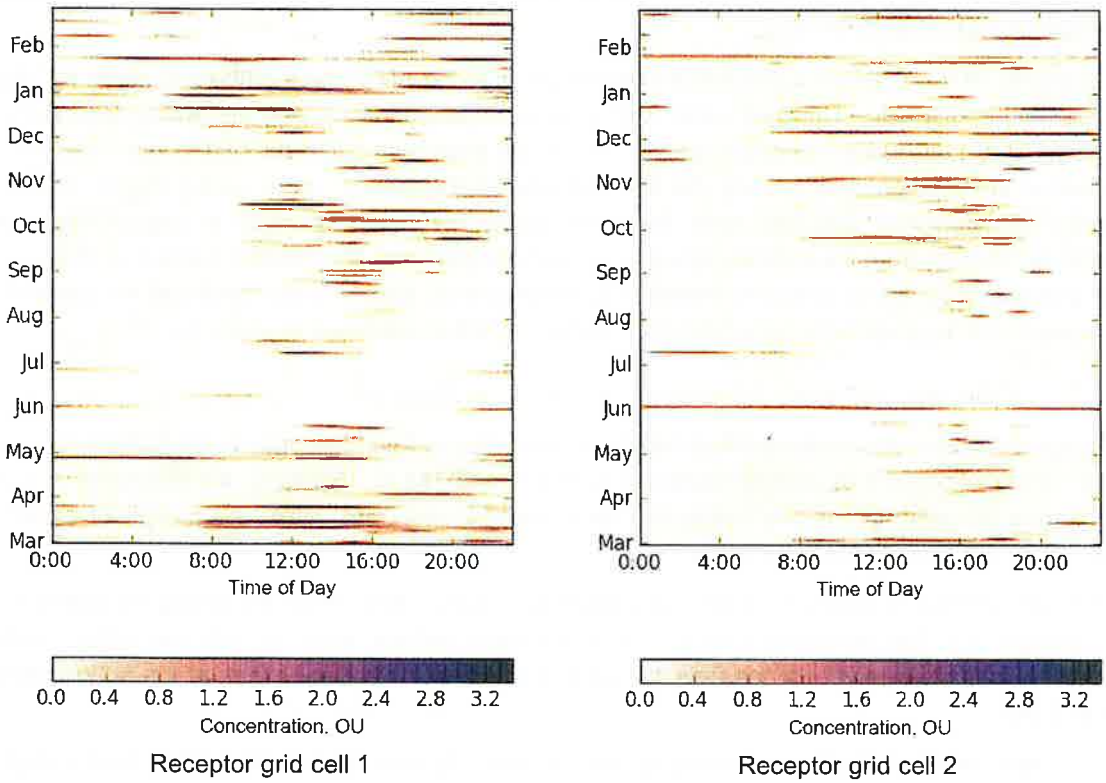


Figure 10-2 Heat maps illustrating cumulative ground-level odour concentrations associated with the Dryer Kiln stack and fugitive asphalt emissions by day of the year and hour of day for receptor grid cells 1-2

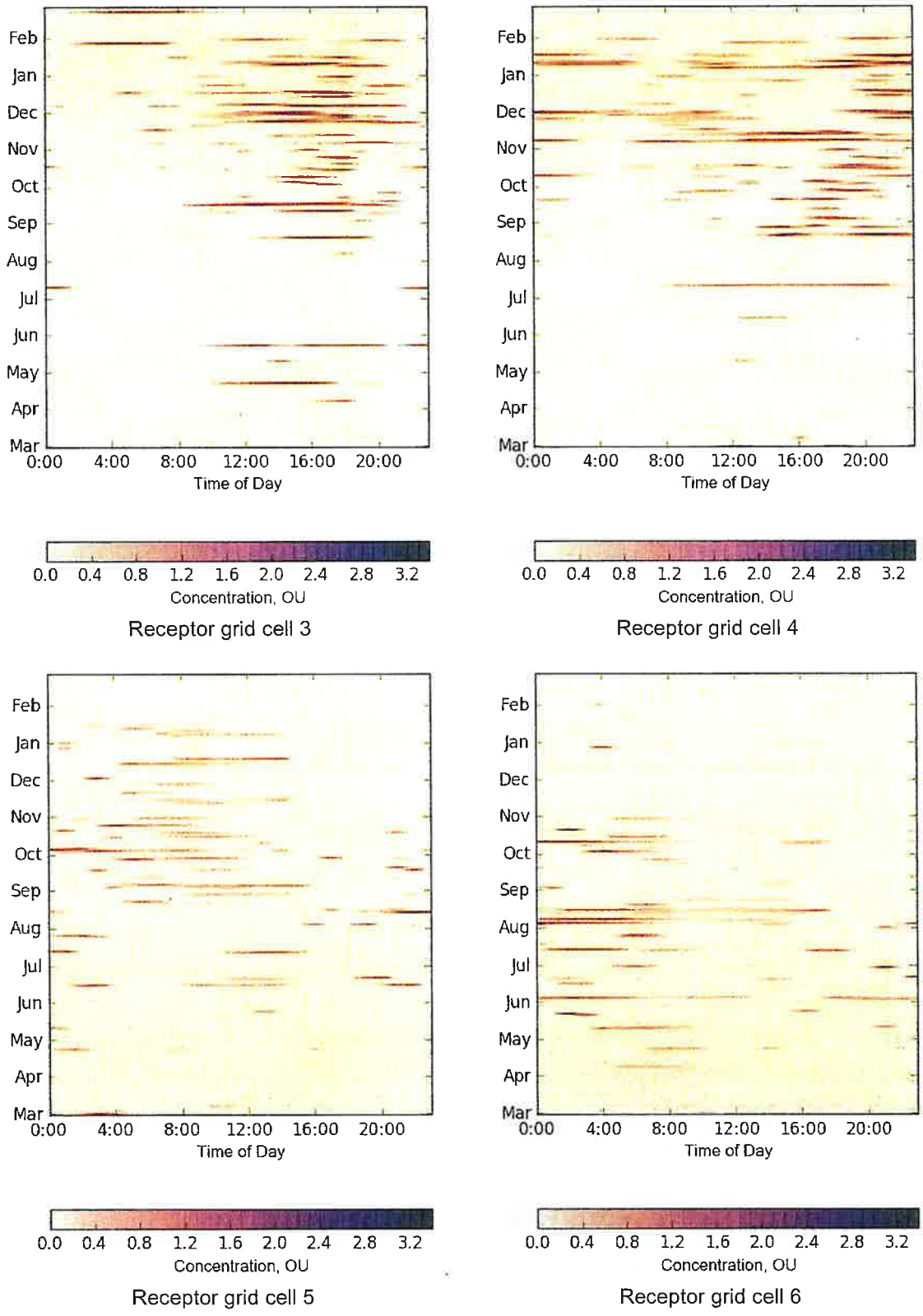


Figure 10-3 Heat maps illustrating cumulative ground-level odour concentrations associated with the Dryer Kiln stack and fugitive asphalt emissions by day of the year and hour of day for receptor grid cells 3-6

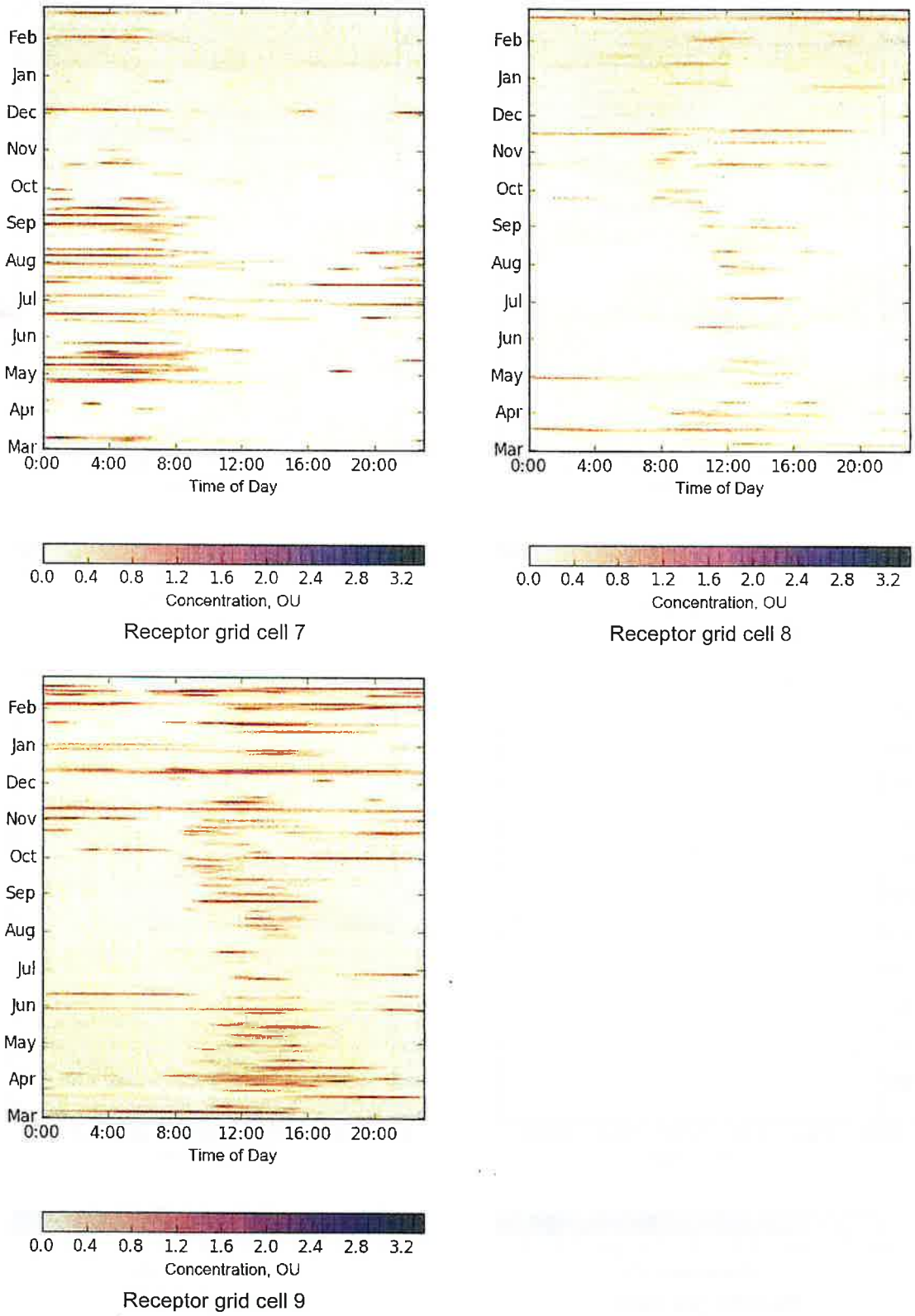


Figure 10-4 **Heat map illustrating cumulative ground-level odour concentrations associated with the Dryer Kiln stack and fugitive asphalt emissions by day of the year and hour of day for receptor grid cells 7-9**

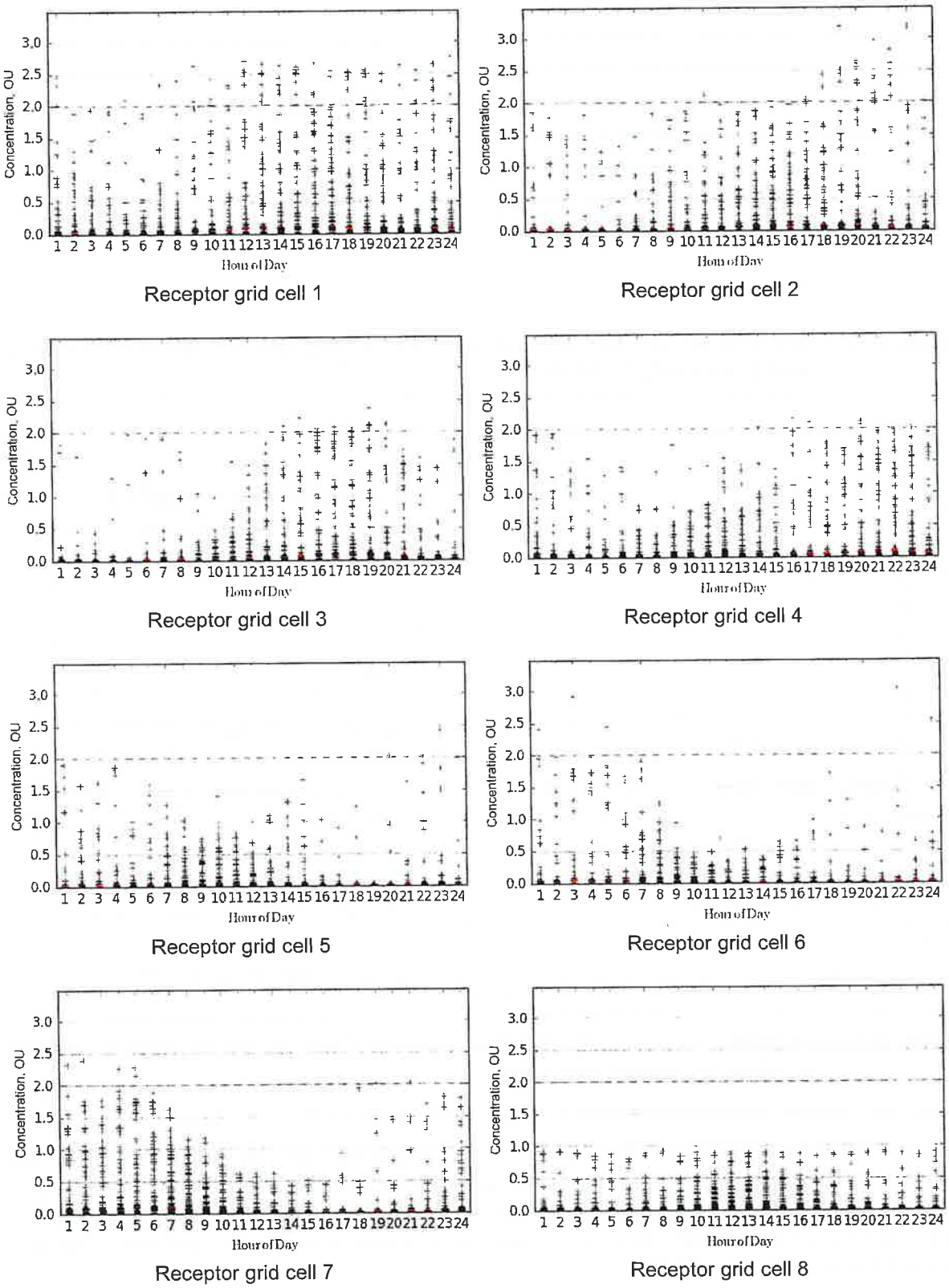
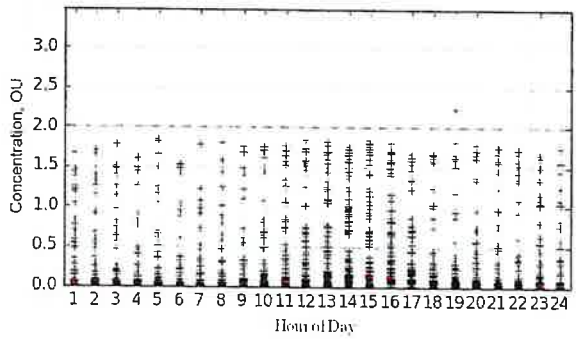


Figure 10-5 **Box and whisker plot distributions of odour concentrations by hour of day at sensitive receiver locations 1- 8**



Receptor grid cell 9

Figure 10-6 **Box and whisker plot distributions of odour concentrations by hour of day at sensitive receiver location 9**

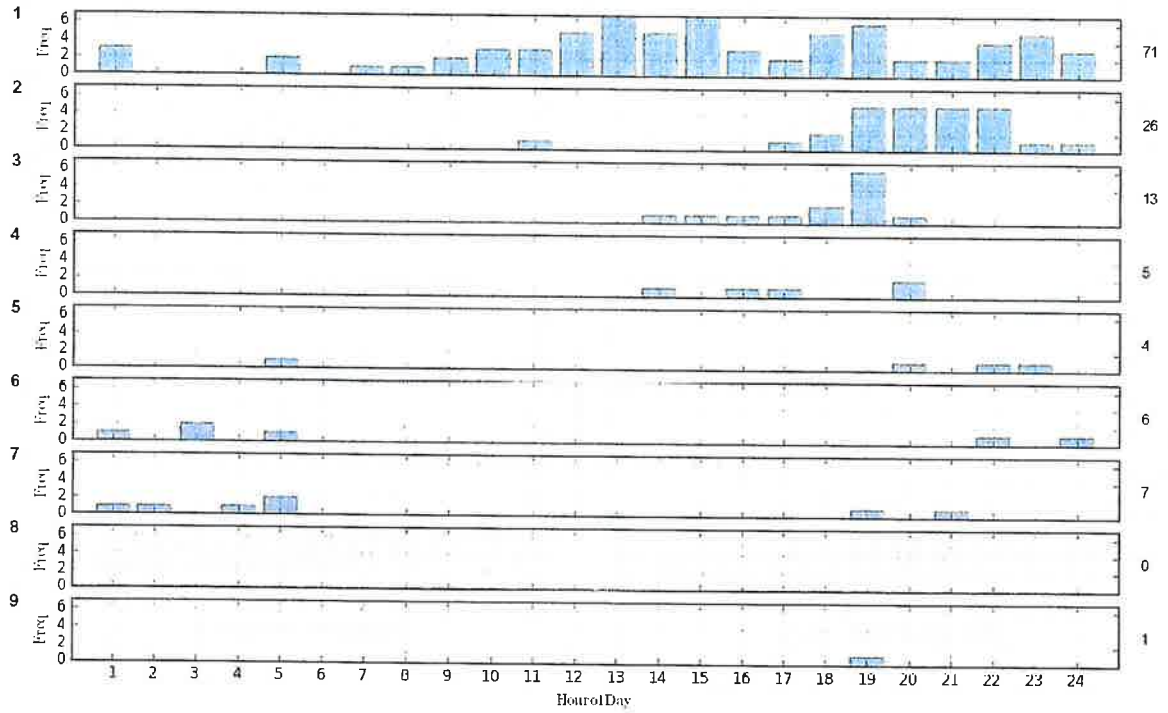


Figure 10-7 **Frequency distributions of odour concentrations ≥2 OU by hour of day at sensitive receiver locations 1-9**

This analysis shows that although the ground-level odour concentrations are not predicted to exceed the odour criterion, as the 2 OU threshold is not exceeded in more than 88 hours of the year, some level of odour is likely to be experienced in each area. However, due to the diurnal and seasonal variation of the wind flows, different areas are susceptible to odour impact at different times of the day, and in different months of the year.

The analysis also shows that ground-level odour concentrations greater than 2 OU are not predicted at Location 8. This is likely to be a factor of the wind direction, terrain and its further distance from the source compared to the other locations. Furthermore, only one instance of odour above 2 OU was predicted at Location 9, which like Location 8, is also to the north of the asphalt plant.

By contrast, Location 1, which is slightly to the west of Location 9, is predicted to be the most affected receptor area and experiences one second odour concentrations greater than 2 OU during 71 hours of the year. This location is predicted to be susceptible to odour impact throughout most of the year with a slightly lower frequency in the winter, while the diurnal profile indicates that daytime and evening conditions are most prevalent for odour concentrations greater than 2 OU, with a lower frequency of impact in the period between midnight and sunrise.

Receptor Locations 5 – 9 to the southeast, east, northeast, north and north-northwest of the plant are predicted to only be susceptible to odour concentrations greater than 2 OU in the evening and night between 6pm and 5am. Meanwhile, Location 2 – 4 to the west, southwest and south of the plant are predicted to be susceptible to very occasional odour concentrations greater than 2 OU during midday and the afternoon, with Location 2 also being impacted through the evening period.

10.1.4 Effect of meteorology on odour impact

In order to investigate the effect of meteorology on odour impact at the sensitive receiver locations, scatter plots were drawn for each location relating predicted odour concentration to selected meteorological parameters. Meteorological time series data were extracted at the location of the Dryer Kiln stack for the entire modelling year for comparison against contemporaneous odour predictions at each sensitive receiver site.

The relationship between odour concentration and wind speed is presented in Figure 10-8.

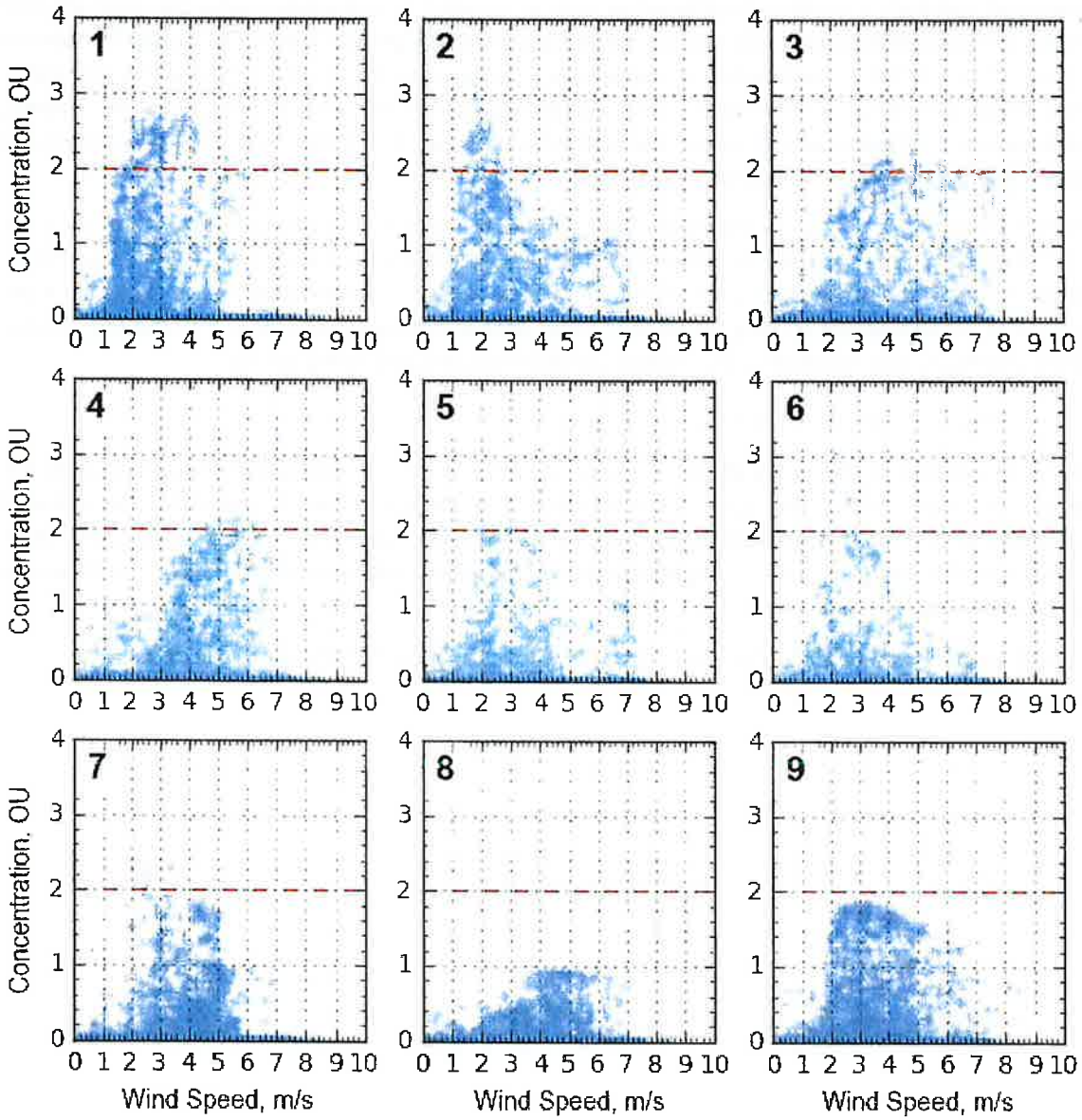


Figure 10-8 Relationship between odour concentration and wind speed at sensitive receiver locations 1-9

Peak odour concentrations at the sensitive receiver locations tend to be associated with light to moderate breezes, varying between about 2 and 7 m/s, suggesting that some degree of wind is necessary to efficiently transport odour from its source to the receptor locations. At each site, there appears to be a wind speed threshold, at between 5 and 7 m/s, beyond which odour concentrations rapidly decline.

The scatter plots for odour concentration against wind direction (Figure 10-9) show that peak odour concentrations at each site are strongly related to wind direction, occurring when winds blow directly from the asphalt plant site to each sensitive receiver. Despite this, odour at concentrations below the odour threshold (1 OU) are often recirculated throughout the modelling domain, arriving at sensitive receptors via an indirect path.

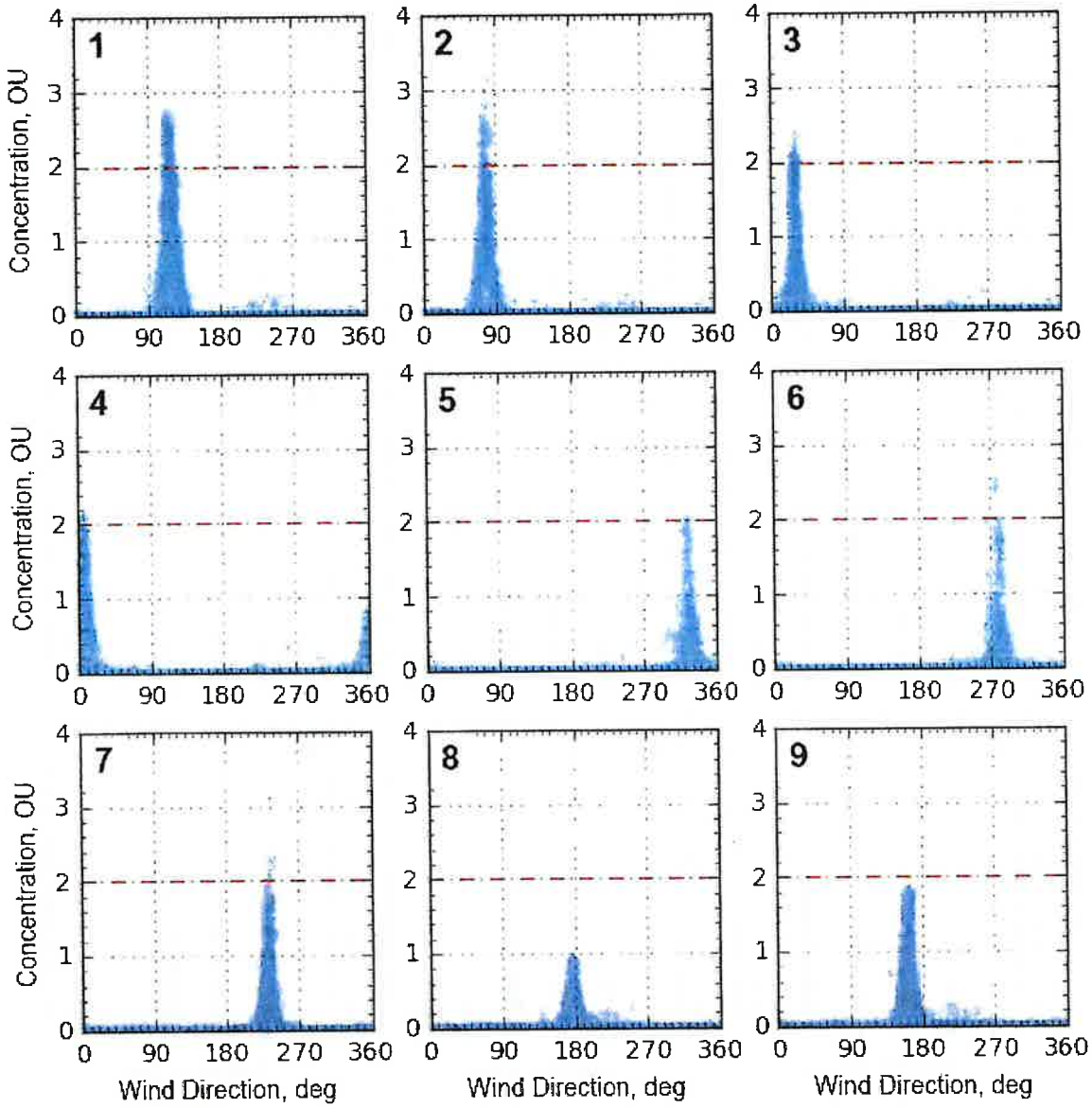


Figure 10-9 Relationship between odour concentration and wind direction at sensitive receiver locations 1-9

Finally, the relationship between odour concentration and atmospheric stability is investigated in Figure 10-10, which indicates that odour is most likely to be detected at the sensitive receiver locationss during neutral and stable atmospheric conditions.

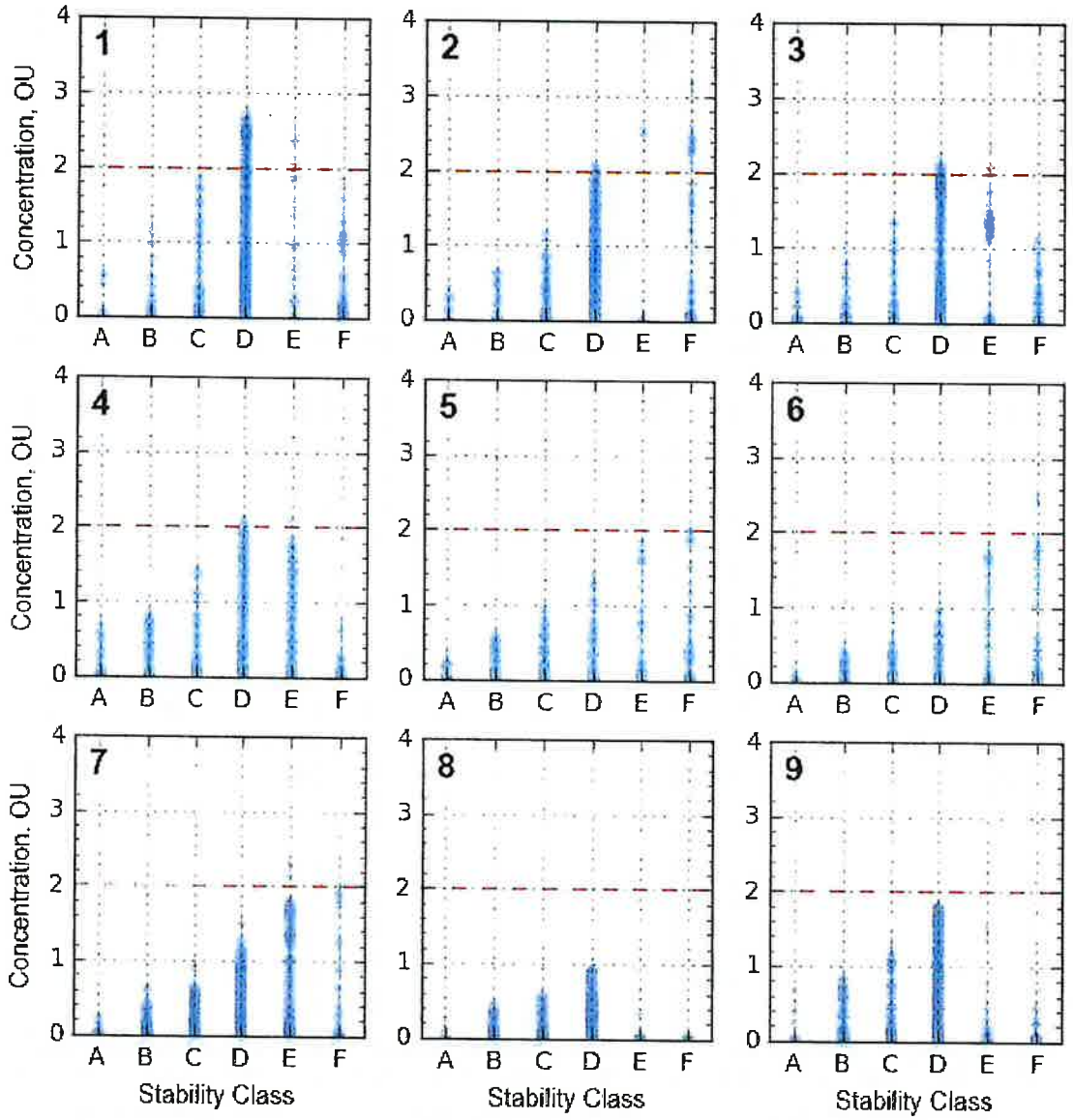


Figure 10-10 Relationship between odour concentration and atmospheric stability class at sensitive receiver locations 1-9

The stack was predicted to be the major contributor to ground-level odour concentrations at all sensitive areas. A well designed tall stack with adequate plume buoyancy would be expected to only generate ground-level odour impacts in a very unstable atmosphere in certain conditions that typically occur during the day when solar insolation is strong and winds are relatively light to calm. This assessment determined that the majority of the odour concentrations greater than 2 OU, and even those above the 1 OU detection threshold, are predicted to occur in the evening, night and early morning, and during light to moderate breezes rather than calm wind conditions. This supports the hypothesis that the stack is affected by turbulence generated by nearby structures that cause the plume to be dispersed close to the ground rather than dispersing high into the atmosphere.

11 Conclusions and Recommendations

The odour impact assessment of the Boral Alstonville facility determined that ground-level odour concentrations associated with air emissions from all sources combined were predicted to comply with the EPA odour impact assessment criterion at all sensitive receiver locations. This assessment was conducted on the basis of the plant's license conditions that allow for its operation during every hour of the year. In reality, the potential for the facility to cause odour impact was significantly lower than that assessed, as the plant only operated for 2.77% of the recent 2016-17 financial year.

The assessment also determined that emissions associated with the Dryer Kiln stack were the largest contributor to ground-level odour concentrations in sensitive residential areas adjacent to the plant. The second most important odour emission source was determined to be the truck load out facility for asphalt product. This conclusion was primarily due to the large difference in odour emissions between the two source types, where emissions from the stack were determined to be 20,444 OU/s compared to approximately 75 OU/s from all asphalt production sources combined. Also important to this finding was the configuration of the stack, which was determined to be affected by turbulence generated by the flow of wind around the nearby plant buildings and structures that were of similar height to the top of the stack.

Notwithstanding the plant's compliance with the odour impact assessment criterion, in acknowledgement of the odour complaints from the community, Air Environment Consulting recommend that further investigations are conducted into their cause. These investigations would include:

- A series of ambient odour assessment surveys to be conducted around the plant and in the local community during production periods to track the odour plume and record its intensity,
- The keeping of an odour complaint log to assist in odour investigations including the establishment of a direct phone line that the community can use to register odour complaints,
- Liaison with the local community by Boral Alstonville operators to investigate the odour impact immediately upon the receipt of a complaint, and
- The analysis of wind and production conditions at the time of complaints based on data recorded at the on-site AWS.

It is also recommended that additional odour sampling and testing of fugitive and stack emissions be conducted to verify the odour emissions inventory. Supplementary odour testing is recommended to monitor odour emissions variability over time and under varying conditions, and their impact in the local area would be further assessed using the odour dispersion model developed for this assessment.

12 References

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Appendix A
AMG Odour Emissions Survey Report

amg

NATA
WORLD RECOGNISED ACCREDITATION
NATA ID: 19703

Assured Monitoring Group

CERTIFICATE OF ANALYSIS | **ODOUR**

Reference: 10737 | **REVISION R_1**

DATE OF RELEASE: | **8/08/2017**

Attention: Mr. Andrew Balch
Air Environment Consulting

INTRODUCTION

AMG accompanied AEC to the Boral Asphalt NSW, Alstonville site to collect a series of odour samples in order for AEC to assess the odour impact of the facility. The following samples were collected.

- One stack emission sample - while process was at 185 degC mix
- One stack emission sample - while process was at 165 degC mix
- Two Bitumen tank emission sample - post carbon filter while tank was filling
- Two flux samples from the back of a truck holding 185 degC mix
- Two flux samples from the back of a tuck holding 165 degC mix

All odour samples were analysed as per AS4323.3.

Samples for intensity were analysed using VDI3882 Part 1, as a guide. There was insufficient sample to run the flux samples more than twice.

Table 1: Revision register

Revision	Date	Name	Issued to	Comment
R_0	01.08.2017	D. Arbuckle	A. Balch	Formal report release
R_1	03.08.2017	D. Arbuckle	A. Balch	Updated temps and typo
R_2	08.08.2017	D. Arbuckle	A. Balch	Added odour character

Table 2: Stack sample results

Source Data		Stack SDS version - 3.08	
Client		AEC	
Site		Boral Asphalt NSW - Alstonville	
Sample Point		Kiln Stack	
Reference Method		AS4323.3 - CONSTANT FLOW	
Test Parameters		odour	
Historical Data & Hardware Information - Manual Sample			
Run Start Date		Tuesday, July 18, 2017	dd-mm-yy
Project ID		10736	
Run ID		-1	
Run Start Time	Ti	7:36:00	hh:mm
Run Stop Time	Tf	10:58:00	hh:mm
Positioning compliance check with AS4323.1		Ideal	
Flow & temperature compliance check with AS4323.1		YES	
Traverse pt factors, up, down, total & trav pts		1 , 1 , 1 , 12	
Console Serial Number		SN368	
Meter Calibration Factor	(Y)	1.044	
Orifice Coefficient		N/A	(DH@)
Pitot Tube Coefficient	(Cp)	0.84	
Actual Nozzle Diameter	(Dna)	N/A	mm
Stack Test Data			
Average Stack Temperature	(ts)avg	76.00	c
Barometric Pressure	(Pb)	1014	mb
Stack Static Pressure	(Pstatic)	20.00	mm H2O
Absolute Stack Pressure	(Ps)	1016	mb
Water vapour concentration	(Bws(calc))	11.51	%
Stack Gas Density Analysis Data			
Carbon Dioxide Percentage	(%CO2)	1.80	%
Oxygen Percentage	(%O2)	18.01	%
Carbon Monoxide Percentage	(%CO)	0.05	%
Nitrogen Percentage	(%N2)	80.14	%
Dry Gas Molecular Weight	(Md)	1.30	kg/Nm3
Dry Gas Molecular Weight	(Md)	29.01	g/g-mole
Wet Stack Gas Molecular Weight	(Ms)	27.74	g/g-mole
Volumetric Flow Rate Data (at Sample Plane)			
Average Stack Gas Velocity	(vs)	18.1	m/sec
Stack Diameter	Ds	1.04	m
Stack Cross-Sectional Area	(As)	0.849	m2
Upstream distance (from disturbance)	B	8.00	m
Downstream distance (from disturbance)	A	6.00	m
Actual Stack Flow Rate	(Qaw)	922.324	m3/min
Wet Standard Stack Flow Rate	(Qsw)	723.579	Nm3/min-wet
Dry Standard Stack Flow Rate	(Qsd)	640.302	Nm3/min-dry
OTHER ANALYTES (PLEASE SPECIFY)			
Odour Sample 1 - 185 deg mix	(Conc)	1,695.23	OU
Odour Sample 1 - 185 deg mix emission rate	(E)	20,443.88	OU/sec
Odour Sample 2 - 165 deg mix	(Conc)	1,263.77	OU
Odour Sample 2 - 165 deg mix emission rate	(E)	15,240.61	OU/sec
Average Odour	(Conc)	1,479.50	OU
Average Odour emission rate	(E)	17,842.24	OU/sec

Table 3: Flux sample results

PROJECT INFORMATION					
Client		AEC	AEC	AEC	AEC
Site		Boral Asphalt NSW - Alstonville	Boral Asphalt NSW - Alstonville	Boral Asphalt NSW - Alstonville	Boral Asphalt NSW - Alstonville
Sampling Location		Truck back	Truck back	Truck back	Truck back
Operating Condition		185 deg C	185 deg C	165 deg C	165 deg C
Source Description		area	area	area	area
Starting Test Date		42,934 00	42,934 00	42,934 00	42,934 00
Operators		DA	DA	DA	DA
Reference Method/s		AS4323 4	AS4323 4	AS4323 4	AS4323 4
Test Parameter/s		odour	Odour	Odour	Odour
EQUIPMENT					
Flux SN		558	AEC flux	558	AEC flux
Flux area	m2	0 13	0 15	0 13	0 15
Project ID		10,737 00	10,737 00	10,737 00	10,737.00
Run ID		1 00	1 00	1 00	1 00
Specific ID		#4	#5	#7	#6
TEST DATA					
Location of sample		Truck back	Truck back	Truck back	Truck back
Sweep air flow rate	lpm	5 00	7 50	5 00	7 50
Source penetration depth	mm	5 00	5 00	5 00	5 00
Ambient temperature	oC	26 20	26 20	27 50	27 50
Flux temperature	oC	83 00	81 00	86 00	85 00
Soil/water/media temperature	oC	83 at surface 163 at 100mm	83 at surface 163 at 100mm	140 at surface 170 at 100mm	140 at surface 170 at 100mm
Barometric pressure	hPa	1,015 00	1,015 00	1,014 00	1,014 00
Flux static pressure (+0 02mb)	mb	0 01	0 01	0 02	0 02
Equilibrium start time	hh:mm	8 29 00 AM	8 29 00 AM	10 28 00 AM	10 28 00 AM
Equilibrium end time	hh:mm	9 37 00 AM	9 37 00 AM	11 10 00 AM	11 10 00 AM
Equilibrium time	hh:mm	1 08	1 08	0 42	0 42
Sample start time	hh:mm	9 37 00 AM	9 37 00 AM	11 10 00 AM	11 10 00 AM
Sample end time	hh:mm	10 03 00 AM	10 06 00 AM	11 28 00 AM	11 31 00 AM
Sample time	hh:mm	12 26 00 AM	12 29 00 AM	12 18 00 AM	12 21 00 AM
Sample flow rate required	lpm	2 5	3 75	2 5	3 75
ANALYSIS					
ODOUR	ou	857	568	964	639
ODOUR emission rate	ou/m2/min	33 26	33 07	37 42	36 95
ODOUR emission rate AV	ou/m2/min	33 17		34 68	

Table 4: Bitumen sample results

Source Data			
Client		AEC	
Site		Boral Asphalt NSW - Alstonville	
Sample Point		Bitument tank #2 carbon filter outlet	
Reference Method		AS4323.3 - CONSTANT FLOW	
Test Parameters		odour	
Process conditions		filling	
Historical Data & Hardware Information - Manual Sample			
Run Start Date		Tuesday, July 18, 2017	dd-mm-yy
Project ID		10736	
Run ID		1 & 2	
Sample 1	Ti	09:23-09:27	hh:mm
Sample 2	Tf	09:28-09:32	hh:mm
OTHER ANALYTES (PLEASE SPECIFY)			
Sample 1 - OU		399.00	OU
Sample 2 - OU		423.00	OU

Table 5: Odour intensity screening – stack sample

Sample ID	10736-1-1	Stack sample
Intensity start dilution	908	

		P1 Run 1		P2 Run 1		P3 Run 1		P4 Run 1	
Challenge #	Dilution	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	1	y	1	y	1	y	0	n
3	256	1	y	2	y	2	y	1	y
4	128	2	y	2	y	2	y	2	y
5	64	3	y	3	y	3	y	3	y
6	32	4	y	4	y	3	y	4	y
7	16	5	y	5	y	4	y	5	y

		P1 Run 2		P2 Run 2		P3 Run 2		P4 Run 2	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	1	y	1	y	0	n	0	n
3	256	1	y	1	y	1	y	1	y
4	128	2	y	2	y	2	y	1	y
5	64	3	y	2	y	3	y	2	y
6	32	4	y	3	y	4	y	3	y
7	16	5	y	4	y	4	y	4	y

		P1 Run 3		P2 Run 3		P3 Run 3		P4 Run 3	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	1	y	1	y	0	n	0	n
3	256	1	y	2	y	1	y	1	y
4	128	2	y	2	y	2	y	2	y
5	64	3	y	3	y	3	y	3	y
6	32	4	y	4	y	4	y	4	y
7	16	5	y	5	y	5	y	4	y

Table 6: Odour intensity screening – Bitumen Tank

Sample ID	10736-2-1	Bitumen Tank Carbon filter outlet
Intensity start dilution	568	

		P1 Run 1		P2 Run 1		P3 Run 1		P4 Run 1	
Challenge #	Dilution	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	4	y	3	y	3	y	2	y
3	256	6	y	5	y	4	y	3	y
4	128	6	y	6	y	5	y	4	y
5	64	6	y	6	y	6	y	6	y
6	32	6	y	6	y	6	y	6	y
7	16								
8	8								

		P1 Run 2		P2 Run 2		P3 Run 2		P4 Run 2	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	3	y	2	y	2	y	0	n
3	256	4	y	4	y	3	y	2	y
4	128	6	y	6	y	4	y	4	y
5	64	6	y	6	y	5	y	5	y
6	32	6	y	6	y	6	y	6	y
7	16								
8	8								

		P1 Run 3		P2 Run 3		P3 Run 3		P4 Run 3	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	3	y	3	y	2	y	0	n
3	256	5	y	5	y	3	y	3	y
4	128	6	y	6	y	4	y	4	y
5	64	6	y	6	y	5	y	6	y
6	32	6	y	6	y	6	y	6	y
7	16								
8	8								

Table 7: Odour intensity screening – 185 degC mix

Sample ID	10736-5-I	185 deg C mix
Intensity start dilution	2326	

		P1 Run 1		P2 Run 1		P3 Run 1		P4 Run 1	
Challenge #	Dilution	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	2048	0	n	0	n	0	n	0	n
2	1024	0	n	0	n	0	n	1	y
3	512	0	n	0	n	2	y	2	y
4	256	0	n	0	n	3	y	3	y
5	128	1	y	0	n	4	y	4	y
6	64	2	y	2	y	4	y	5	y
7	32	3	y	3	y	5	y	5	y
8	16	4	y	4	y	5	y	5	y

		P1 Run 2		P2 Run 2		P3 Run 2		P4 Run 2	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	2048	0	n	0	n	0	n	0	n
2	1024	0	n	0	n	0	n	1	y
3	512	0	n	0	n	1	y	2	y
4	256	1	y	0	n	2	y	3	y
5	128	1	y	0	n	3	y	4	y
6	64	2	y	1	y	4	y	5	y
7	32	3	y	2	y	5	y	5	y
8	16	4	y	4	y	5	y	5	y

		P1 Run 3		P2 Run 3		P3 Run 3		P4 Run 3	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	2048								
2	1024								
3	512								
4	256	INSUFFICIENT SAMPLE TO RUN A THIRD TIME							
5	128								
6	64								
7	32								
8	16								

Table 8: Odour intensity screening – 165 degC mix

Sample ID	10736-6-1	165 deg C mix
Intensity start dilution	908	

		P1 Run 1		P2 Run 1		P3 Run 1		P4 Run 1	
Challenge #	Dilution	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	0	n	0	n	1	y	0	n
3	256	0	n	0	n	1	y	1	n
4	128	2	y	1	y	2	y	1	y
5	64	3	y	4	y	3	y	2	y
6	32	4	y	5	y	4	y	3	y
7	16	5	y	5	y	5	y	4	y
8	8	5	y	5	y	5	y	5	y

		P1 Run 2		P2 Run 2		P3 Run 2		P4 Run 2	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024	0	n	0	n	0	n	0	n
2	512	0	n	0	n	0	y	0	n
3	256	0	n	0	n	1	y	0	n
4	128	1	y	1	y	2	y	1	y
5	64	2	y	3	y	3	y	2	y
6	32	3	y	4	y	4	y	3	y
7	16	4	y	5	y	5	y	4	y
8	8	4	y	5	y	5	y	5	y

		P1 Run 3		P2 Run 3		P3 Run 3		P4 Run 3	
Challenge #		Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No	Intensity	Yes/No
1	1024								
2	512								
3	256								
4	128		INSUFFICIENT SAMPLE TO RUN A THIRD TIME						
5	64								
6	32								
7	16								
8	8								

Table 9: Odour character

Source	Character
Truck 165degC mix	Asphalt/road surface
Truck 185degC mix	Asphalt/road surface
Stack 165degC mix	Slight chlorine[a], moist soil
Stack 165degC mix	Slight chlorine[b], moist soil
Bitumen tank exhaust	Asphalt/road surface

[a] A slight chlorine smell in a combustion source is typically nitrogen oxides.
[b] A slight chlorine smell in a combustion source is typically nitrogen oxides.

Appendix B

Selection of a Representative Year of Meteorology for the Modelling Assessment

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1 Methodology for the Assessment of Meteorological Inter-annual Variability

1.1 Review and selection of regional meteorological observations

The nearest available automatic weather station (AWS) to the project area operated by the Bureau of Meteorology (BoM) is located at Ballina Airport.

Meteorological data from the airport AWS were reviewed to determine its suitability for use in selecting a representative year for the modeling and for evaluating the meteorological model's performance.

1.2 Analysis of regional meteorological observations

Five years of data were selected for analysis with each year being compared against the five-year mean to determine its representativeness. Rather than using calendar years AEC have defined the 'meteorological year' as the twelve-month period commencing in June each year and ending in May the following year. If a calendar year had been selected, it would commence with the end of one year's wet season and end with the beginning of another. The adopted approach therefore ensures that a single wet season will be modelled in its entirety.

The meteorological parameters analysed, dataset time interval and analyses conducted are summarised in Table 1-1.

Table 1-1 Meteorological data assessed for the Ballina Airport (BoM station number 058198)

Parameter	Time period assessed	Data	Analysis
Wind speed Wind direction Wind vector U component Wind vector V component Air temperature Dew point temperature Surface atmospheric pressure	1 March 2011 – 28 February 2016	30 minute data points from BoM AWS	Comparisons of: • Frequency distributions (as probability density functions) as year on year and each year against the mean of all five years; • Frequency distribution anomaly (as a percentage) from the mean of all five years; • Correlation statistics (R^2).
Rainfall	March 2011 – February 2016	Annual and monthly totals (mm)	Comparison of monthly and annual rainfall totals
El Niño Southern Oscillation	March 2011 – February 2016	Monthly Southern Oscillation Index	SOI classification and strength

The selection process was based on determining which years provided the closest representation of the average state of the climate based on the variation of each meteorological parameter from the mean and each other year. For meteorological modelling and air quality assessment purposes, the key parameters that influence pollutant dispersion are wind speed, wind direction, atmospheric stability and mixing height, with stability a function of the atmosphere's vertical temperature profile and the wind speed. Notwithstanding this, these parameters can be strongly influenced by the overall state of the

climate including the El Niño Southern Oscillation (ENSO), solar exposure, cloud cover and rainfall and the resulting soil and atmospheric moisture content. In general, the analysis considered the following:

- A year with a moderate or strong ENSO classification should be avoided, where possible.
- A year with anomalously low or high rainfall should be avoided, where possible.
- The distributions of wind speed and direction should be as close to the mean distribution as possible, both in terms of the frequencies of low, moderate and high wind speeds, and in the overall correlation statistics. This includes the analysis of wind in its U and V vector components.
- The distributions of temperature should be as close to the mean distribution as possible, in terms of low nocturnal and daytime high temperatures.
- The distributions of dew point temperature should be as close to the mean distribution as possible.
- The distributions of mean sea level atmospheric pressure should be as close to the mean distribution as possible.

2 Analysis of Meteorological Inter-annual Variability

2.1 Wind speed

The annual and mean frequency distributions (probability density function [PDF]) of wind speed and the anomaly of each year to the mean of the five-year period, March 2011 to February 2016, are presented in Figure 2-1 and Figure 2-2, respectively.

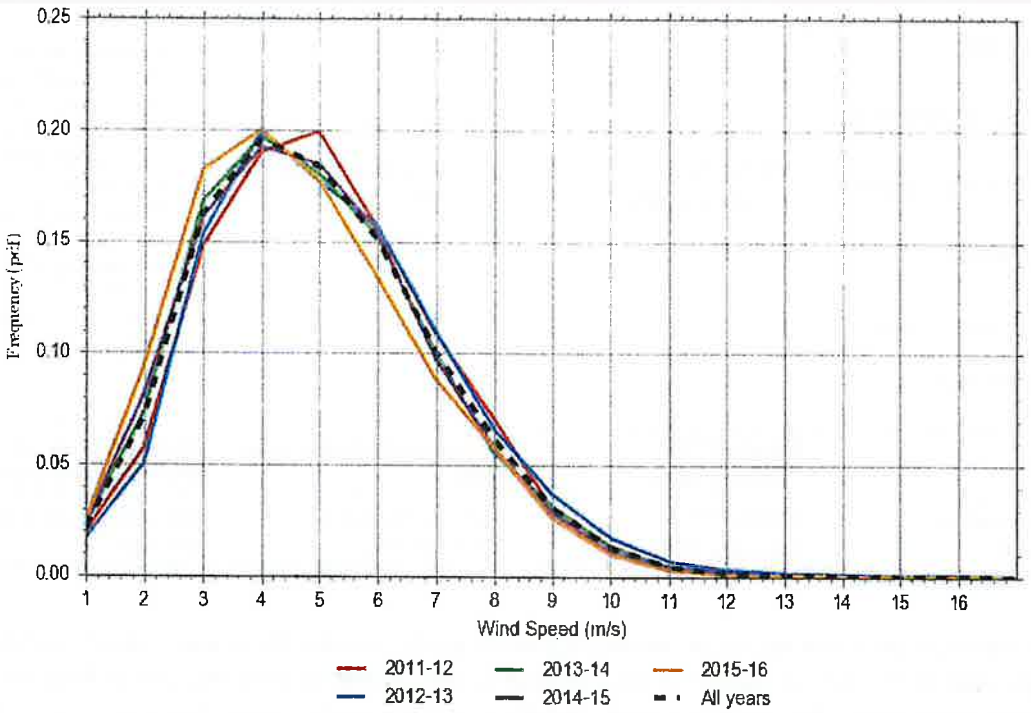

Figure 2-1 Comparison of annual observed wind speed frequency distributions to the mean

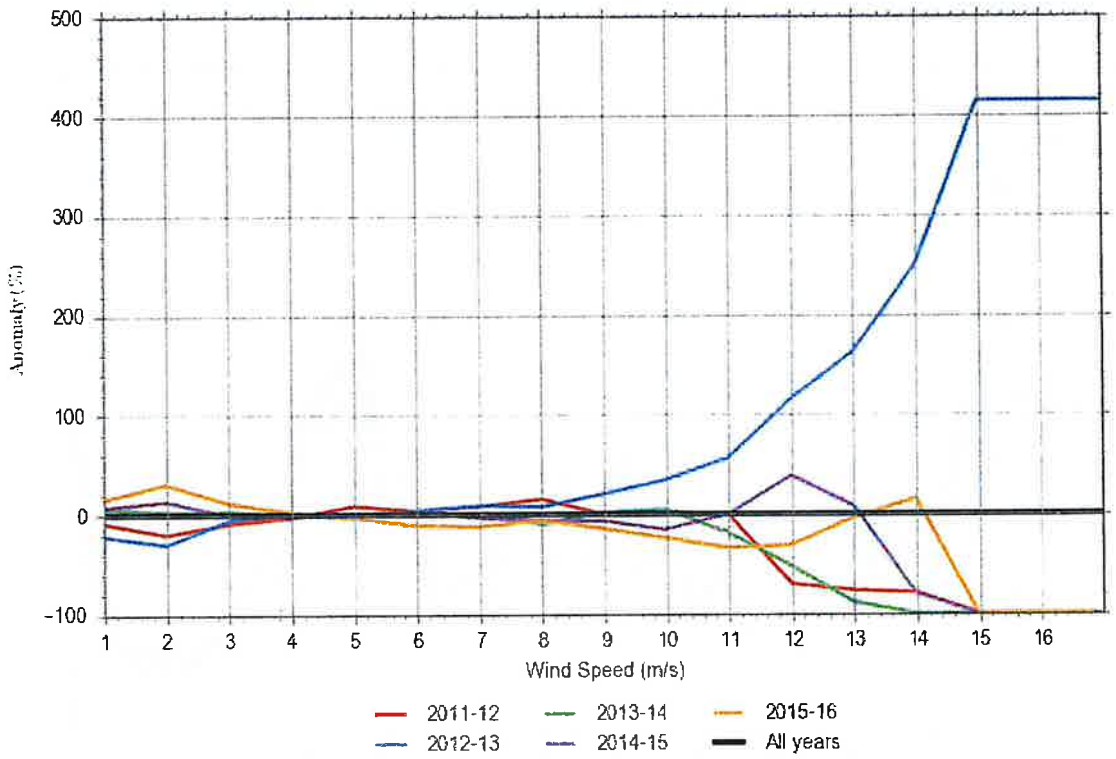

Figure 2-2 Annual observed wind speed frequency distribution anomaly from the mean

The R^2 correlation statistics for each year on year, and each year versus the mean of all years, are summarised in Table 2-1.

Table 2-1 Correlation coefficients matrix of the distributions of wind speed

Period	2011-12	2012-13	2013-14	2014-15	2015-16	All years
2011-12	1					
2012-13	0.9954	1				
2013-14	0.9916	0.9933	1			
2014-15	0.9923	0.9906	0.9989	1		
2015-16	0.975	0.9758	0.9933	0.9927	1	
All years	0.9947	0.9948	0.9995	0.999	0.9917	1

2.2 Wind direction

The annual and mean wind direction PDF and the anomaly of each year to the mean of the five-year period (March 2011 to February 2016), are similarly presented in Figure 2-3 and Figure 2-4, respectively.

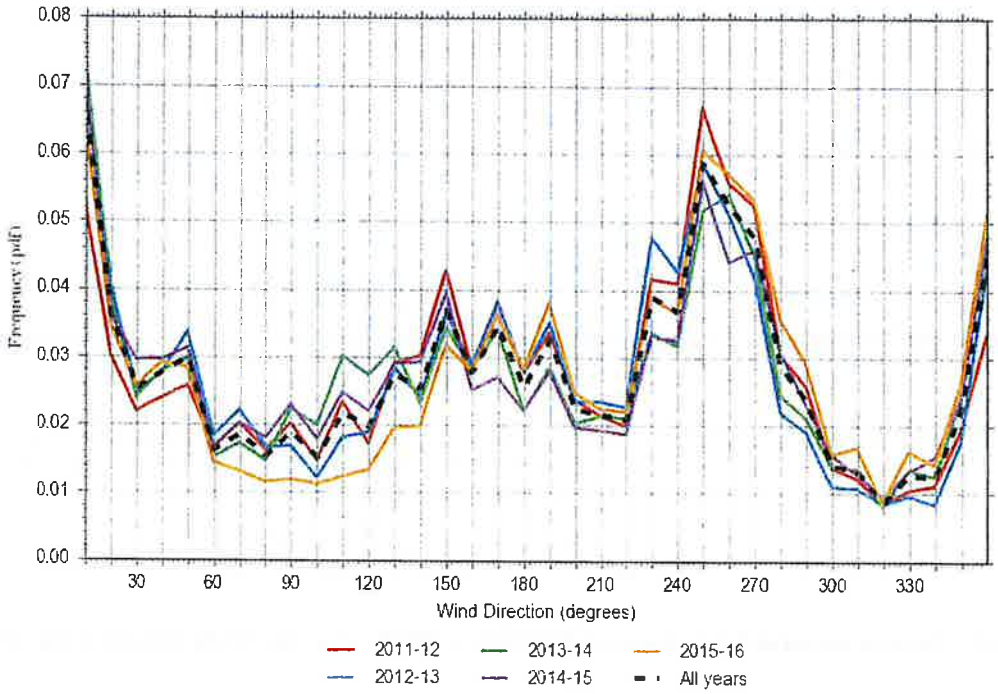

Figure 2-3 Comparison of annual observed wind direction frequency distributions to the mean

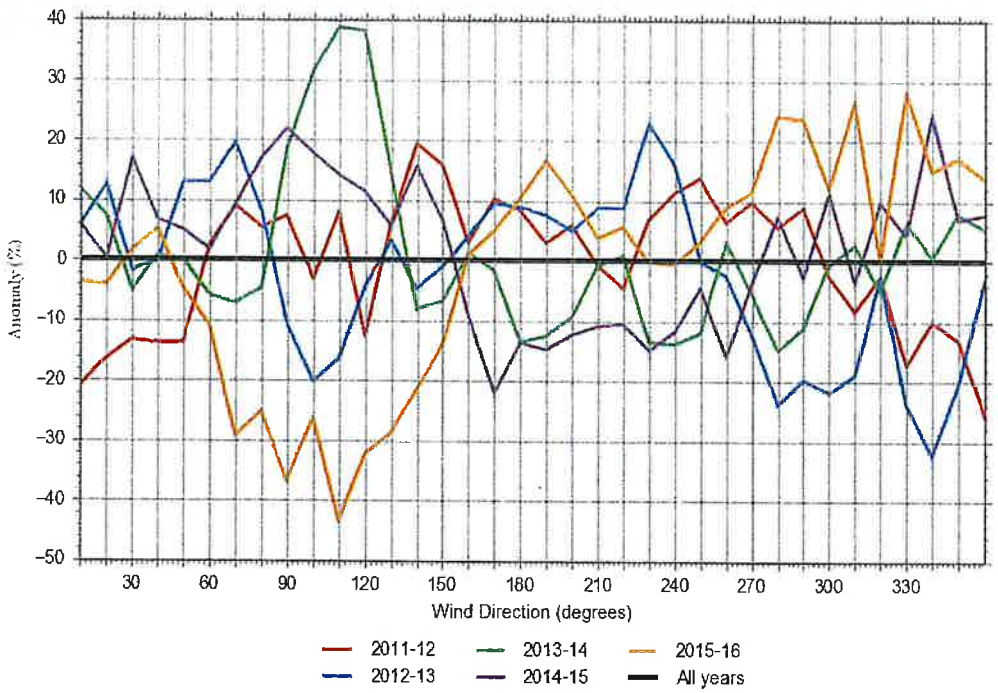

Figure 2-4 Annual observed wind direction frequency distribution anomaly from the mean

The R^2 correlation statistics for each year on year, and each year versus the mean of all years, are summarised in Table 2-2.

Table 2-2 Correlation coefficients matrix of the distributions of wind direction

Period	2011-12	2012-13	2013-14	2014-15	2015-16	All years
2011-12	1					
2012-13	0.9216	1				
2013-14	0.87	0.9307	1			
2014-15	0.8833	0.9231	0.9634	1		
2015-16	0.9062	0.9144	0.8898	0.8999	1	
All years	0.9507	0.9738	0.9649	0.9681	0.9595	1

2.3 Wind U component

The annual and mean wind U component PDF, and the anomaly of each year to the mean of the five-year period (March 2011 to February 2016), are presented in Figure 2-5 and Figure 2-6, respectively.

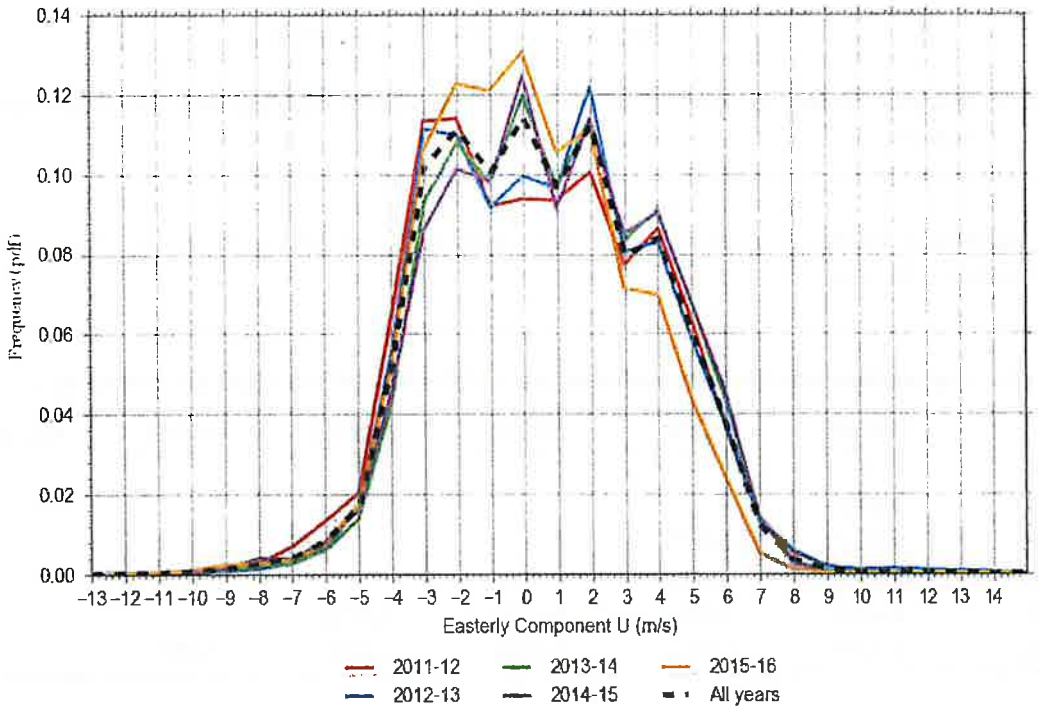

Figure 2-5 Comparison of annual observed wind U-component frequency distributions to the mean

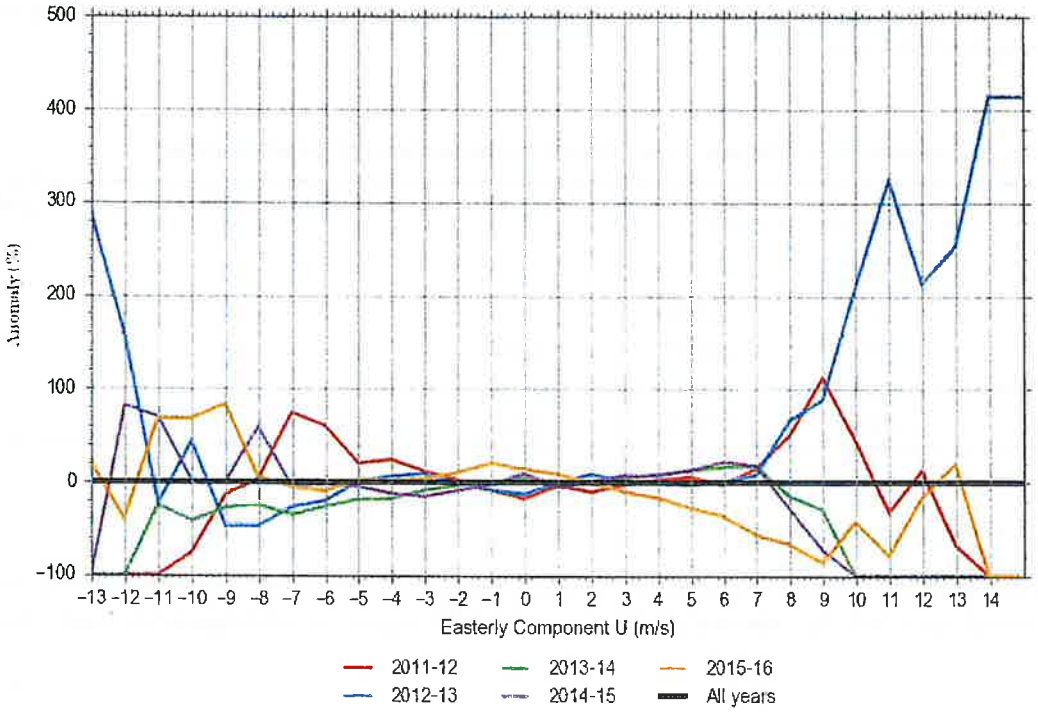

Figure 2-6 Annual observed wind U-component frequency distributions anomaly from the mean

The R^2 correlation statistics for each year on year, and each year versus the mean of all years, are summarised in Table 2-2.

Table 2-3 Correlation coefficients matrix of the distributions of the wind U-component

Period	2011-12	2012-13	2013-14	2014-15	2015-16	All years
2011-12	1					
2012-13	0.9935	1				
2013-14	0.9816	0.9889	1			
2014-15	0.9749	0.983	0.9985	1		
2015-16	0.9723	0.9771	0.9771	0.9732	1	
All years	0.9911	0.9954	0.9964	0.9932	0.9877	1

2.4 Wind V component

The annual and mean wind V component PDF, and the anomaly of each year to the mean of the five-year period (March 2011 to February 2016), are presented in Figure 2-7 and Figure 2-8, respectively.

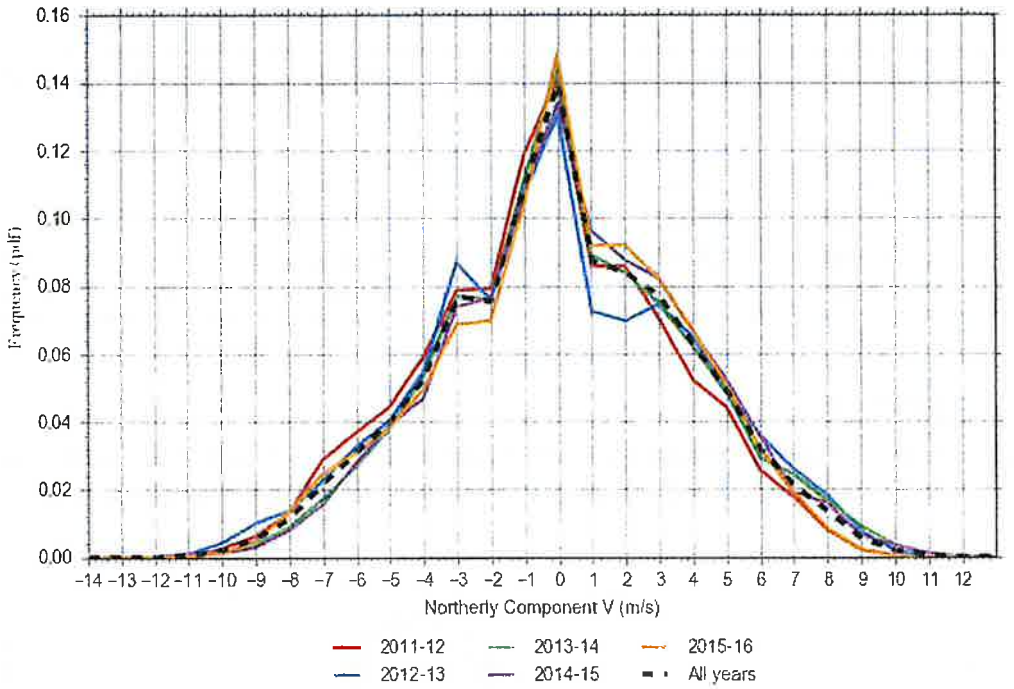

Figure 2-7 Comparison of annual observed wind V-component frequency distributions to the mean

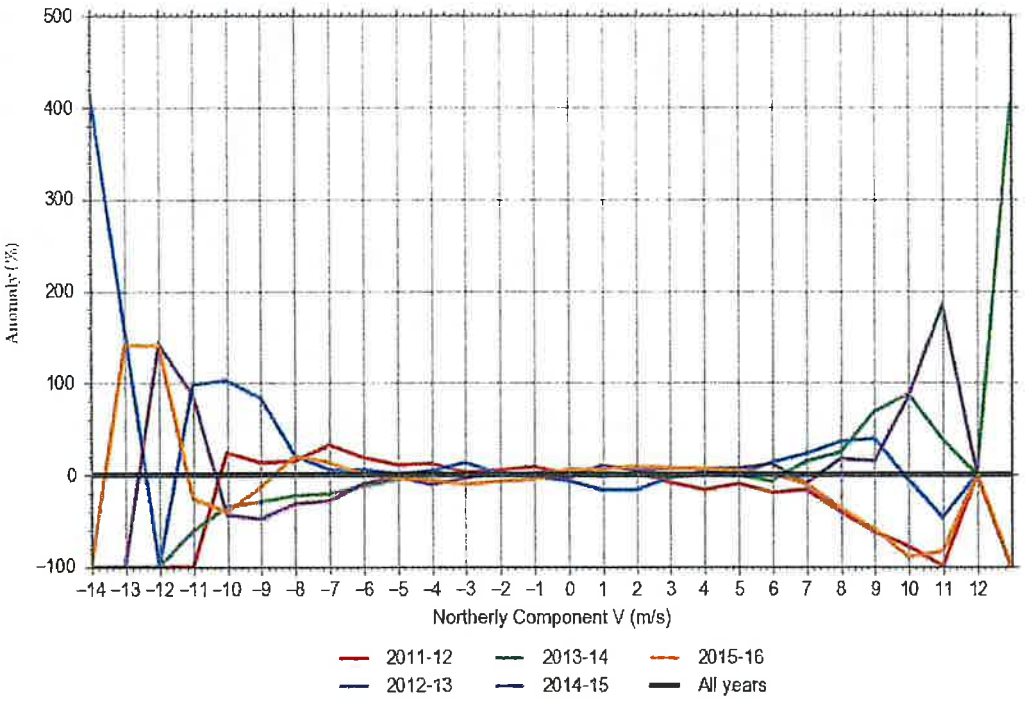

Figure 2-8 Annual observed wind V-component frequency distributions anomaly from the mean

The R^2 correlation statistics for each year on year, and each year versus the mean of all years, are summarised in Table 2-2.

Table 2-4 Correlation coefficients matrix of the distributions of the wind V-component

Period	2011-12	2012-13	2013-14	2014-15	2015-16	All years
2011-12	1					
2012-13	0.9862	1				
2013-14	0.9913	0.9904	1			
2014-15	0.9838	0.9843	0.995	1		
2015-16	0.9868	0.9807	0.9932	0.9938	1	
All years	0.9941	0.9925	0.9986	0.9962	0.9957	1

2.5 Temperature

The annual and mean PDF temperature PDF and anomaly PDF of each year to the mean of the five-year period, March 2011 to February 2016, are presented in Figure 2-9 and Figure 2-10, respectively.

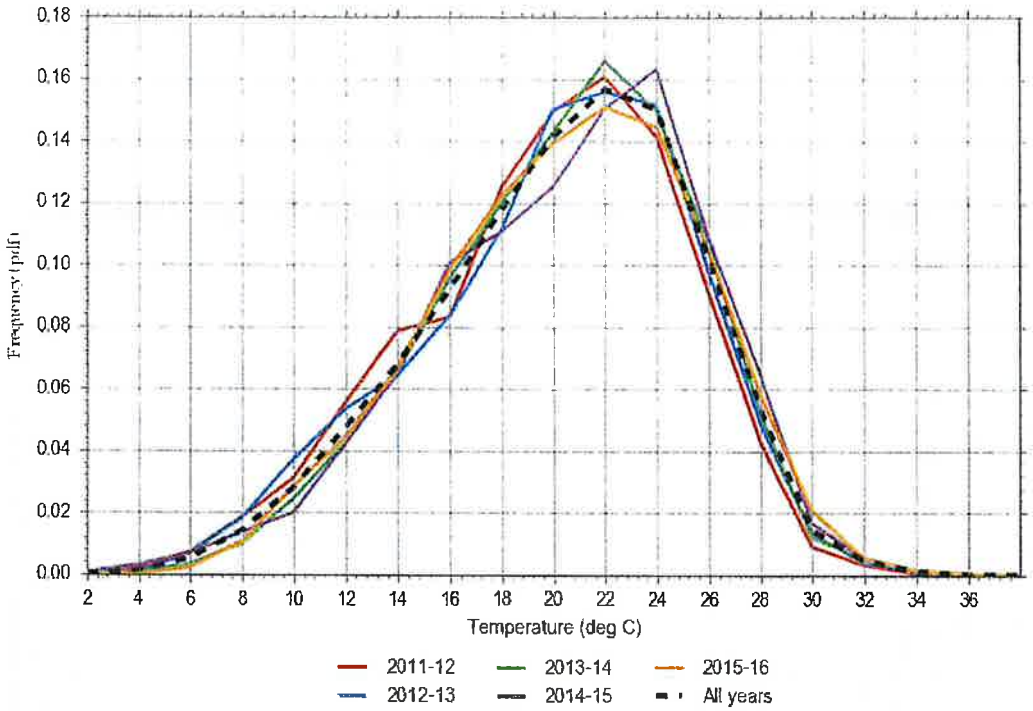

Figure 2-9 Comparison of annual observed temperature frequency distributions to the mean

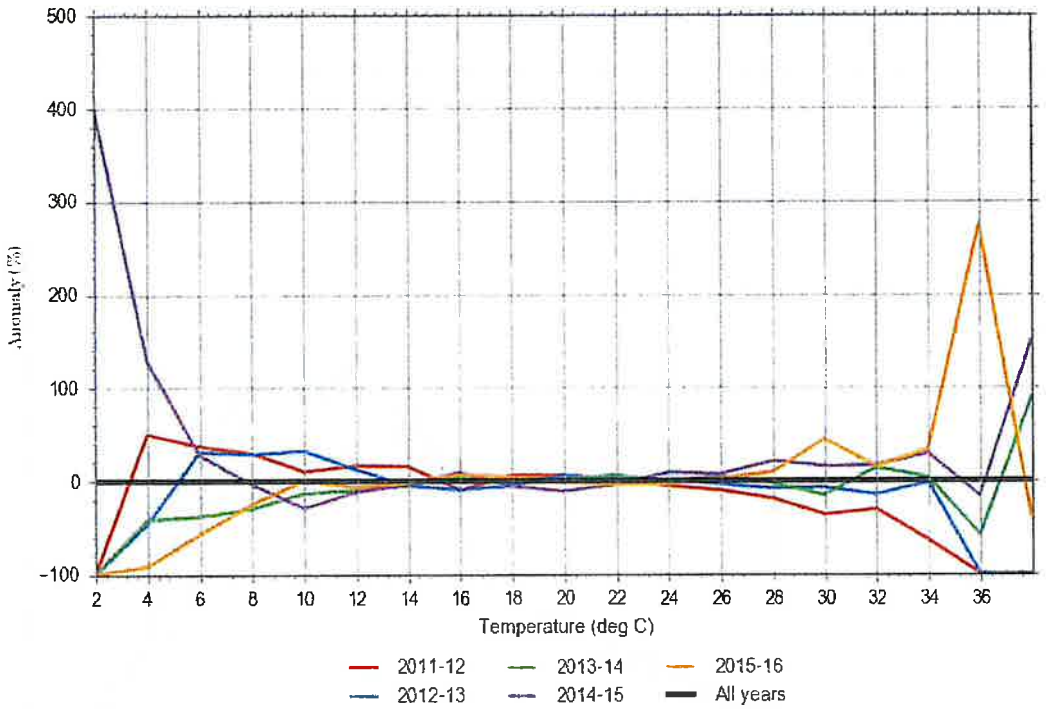

Figure 2-10 Annual observed temperature frequency distribution anomaly from the mean

The R^2 correlation statistics for each year on year, and each year versus the mean of all years, are summarised in Table 2-5.

Table 2-5 Correlation coefficients matrix of the distributions of temperature

Period	2011-12	2012-13	2013-14	2014-15	2015-16	All years
2011-12	1					
2012-13	0.9944	1				
2013-14	0.9911	0.9938	1			
2014-15	0.974	0.9833	0.9918	1		
2015-16	0.9883	0.9915	0.9975	0.9923	1	
All years	0.9937	0.9967	0.9989	0.9923	0.998	1

2.6 Dew point temperature

The annual and mean dew point temperature PDFs are presented in Figure 2-11.

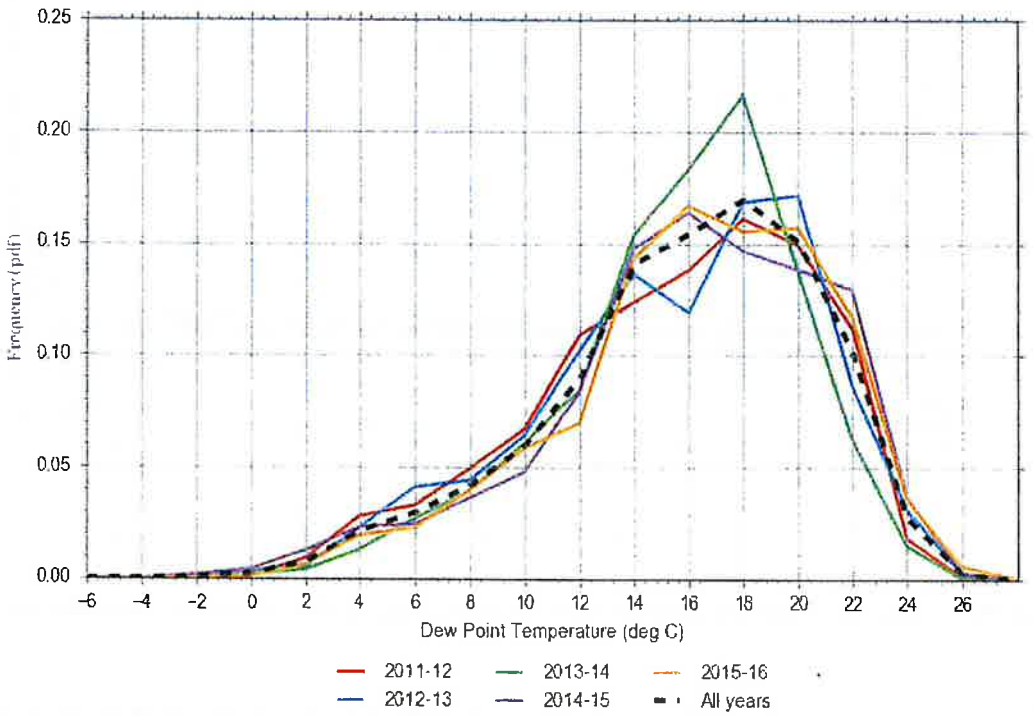

Figure 2-11 Comparison of annual observed dew point temperature frequency distributions to the mean

The R^2 correlation statistics for each year on year, and each year versus the mean of all years, are summarised in Table 2-6.

Table 2-6 Correlation coefficients matrix of the distributions of dew point temperature

Period	2011-12	2012-13	2013-14	2014-15	2015-16	All years
2011-12	1					
2012-13	0.9833	1				
2013-14	0.9469	0.9478	1			
2014-15	0.9723	0.9482	0.9382	1		
2015-16	0.9737	0.9612	0.952	0.9928	1	
All years	0.9899	0.9828	0.9737	0.9851	0.991	1

2.7 Surface atmospheric pressure

The annual and mean sea level pressure PDFs are presented in Figure 2-12.

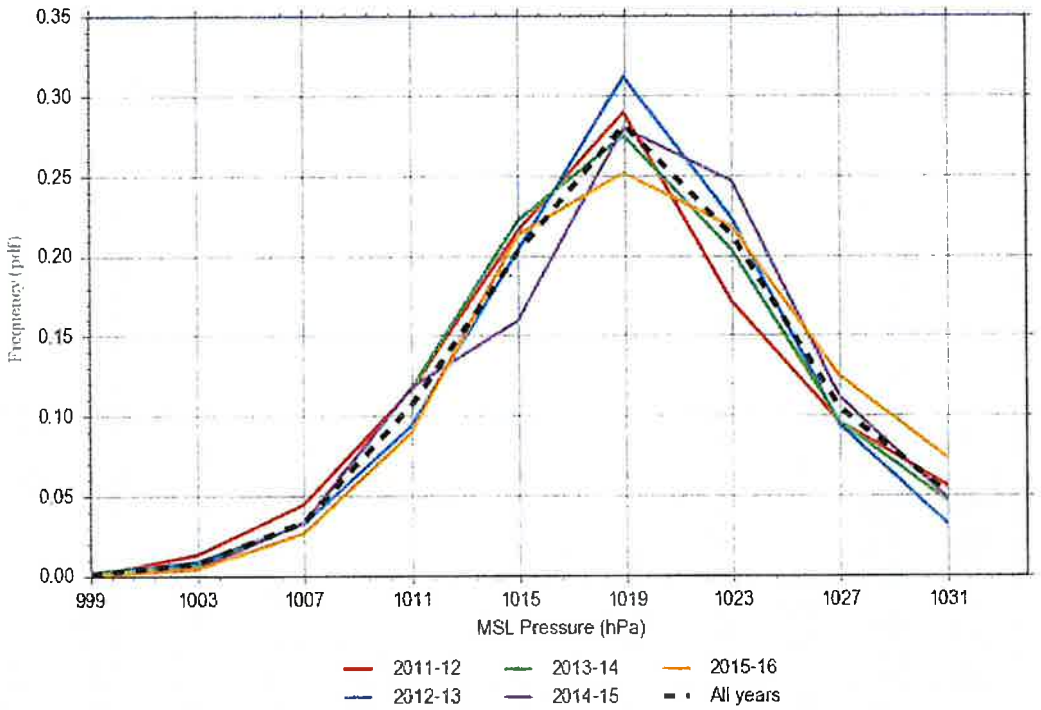

Figure 2-12 Comparison of annual observed mean sea level pressure frequency distributions to the mean

The R^2 correlation statistics for each year on year, and each year versus the mean of all years, are summarised in Table 2-7.

Table 2-7 Correlation coefficients matrix of the distributions of mean sea level pressure

Period	2011-12	2012-13	2013-14	2014-15	2015-16	All years
2011-12	1					
2012-13	0.9805	1				
2013-14	0.9905	0.9878	1			
2014-15	0.9413	0.977	0.9632	1		
2015-16	0.9608	0.9703	0.9802	0.9624	1	
All years	0.9858	0.9949	0.9957	0.9804	0.9857	1

2.8 Rainfall

Monthly rainfall totals for the five-year period, March 2011 to February 2016, are presented in Figure 2-13.

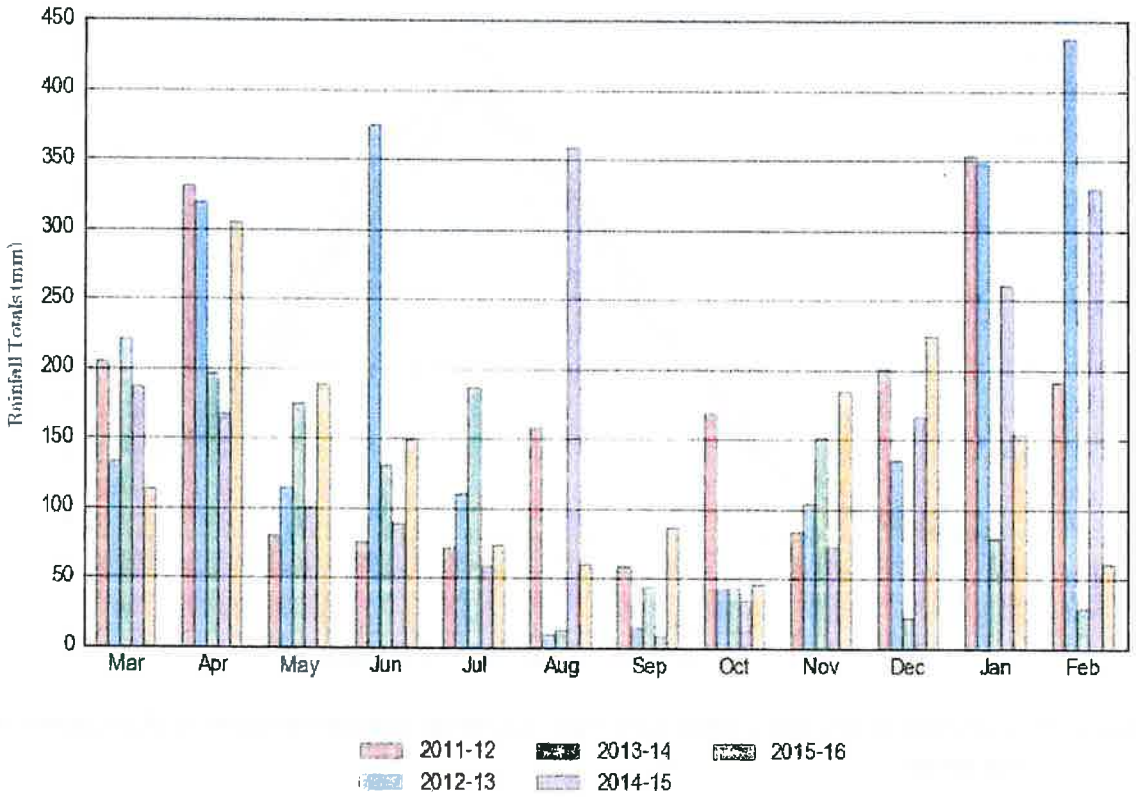

Figure 2-13 Total monthly rainfall anomaly from the mean during the period March 2011 to February 2016

2.9 El Niño Southern Oscillation

The Southern Oscillation Index (SOI), as provided by the Bureau of Meteorology, indicates the development and intensity of El Niño or La Niña events in the Pacific Ocean. Sustained values of the SOI below -7 are indicative of El Niño events causing a reduction in winter and spring rainfall over eastern Australia. Likewise sustained positive values above +7 indicate La Niña events characterised by wetter than normal conditions.

Figure 2-14 shows the monthly SOI for the period from March 2011 to February 2016.

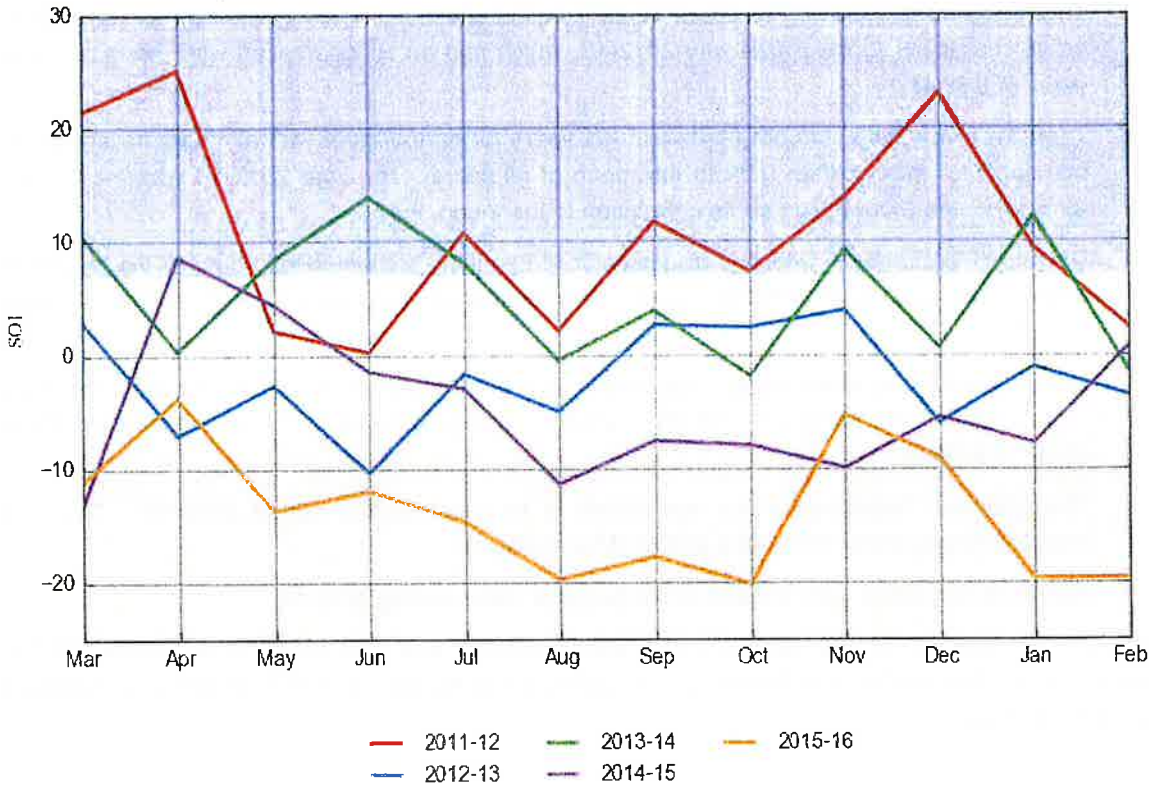

Figure 2-14 Monthly SOI for the period from March 2011 to February 2016

3 Conclusion

The correlation statistics for each meteorological parameter assessed were ranked and aggregated to determine a representative year for the meteorological modelling. The statistic rankings are presented in Table 3-1.

Table 3-1 Rankings of correlation statistics for meteorological parameters

Period	Wind Speed	Wind Direction	Temp.	Dew point temp.	MSL pressure	SOI	Annual rainfall	Aggregate ranking	Final rank
2011-12	4	5	4	2	3	4	3	25	5
2012-13	**3**	**1**	**3**	**4**	**2**	**1**	**4**	**18**	**1**
2013-14	1	3	1	5	1	3	5	19	2
2014-15	2	2	5	3	5	2	1	20	3
2015-16	5	4	2	1	4	5	2	23	4

Table note: The year selected is presented in bold font.

The analysis found that the:

- There was very little variability between the years for wind speed with all years having an R^2 correlation of greater than 0.99 to the mean of all years. Consequently, wind speed was not a limiting factor in the selection. The year 2013-14 was the highest rank for wind speed correlation.

- There was more variability between years for wind direction. The highest ranked year based on its correlation to the mean was 2012-13, which had an R^2 correlation with the mean of al years of 0.9738.
- There was very little variability between the years for temperature with all years having an R^2 correlation of greater than 0.99 to the mean of all years. The year 2013-14 was the highest rank for temperature based on its correlation to the mean.
- Dew point temperature, which is an indicator of humidity, correlated well against the long-term means. The most representative year for dew point temperature was 2015-16, with an R^2 value of 0.991.
- Low variability between years was found for mean sea level pressure, with the most representative year being 2013-14 (R^2 = 0.9957), closely followed by the period selected 2012-13 (R^2 = 0.9949).
- The Southern Oscillation Index was found to be most neutral during 2012-13. The year selected ranged between neutral and El Niño conditions.
- Annual rainfall totals were closest to the five-year mean during 2014-15.

Based on this assessment, the year with the highest ranking was determined to be March 2012 to February 2013. This period was therefore selected as a representative period for the meteorological modelling simulation.

Appendix C

Evaluation of Meteorological Model Performance

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1 Methodology for the Evaluation of Meteorological Model Performance

1.1 Approach to the performance evaluation

To assess model performance, observations at Ballina Aero during the period corresponding to the period for modelling (1 March 2012 to 28 February 2013) was compared with the meteorological data generated by the TAPM prognostic model at the grid closest to Ballina Aero AWS.

The TAPM model's performance in simulating the wind fields in the region, two statistical techniques were used:

1. Comparison of the distributions of key meteorological parameters through presentation of the modelled versus observed probability density functions for the BoM AWS site at Ballina Airport
    a. Wind speed,
    b. Wind direction,
    c. Temperature,
    d. Relative humidity, and
    e. U and V vector wind components.

This analysis provides for the evaluation of the model's ability to predict the correct distributions of important parameters and is a reasonable approach to evaluating meteorological model performance.

2. Correlation of the observed and predicted wind speeds on a time and space basis including –
    a. Mean,
    b. Standard deviation,
    c. Pearson Correlation Coefficient,
    d. Index of Agreement,
    e. Root Mean Square Error (RMSE),
    f. Systematic Root Mean Square Error,
    g. Unsystematic Root Mean Square Error,
    h. Skill_E,
    i. Skill_V, and
    j. Skill_R.

This analysis is more stringent and provides for the evaluation of the model's ability to predict the correct conditions during each hour of the day. In general for a model such as TAPM, it is unrealistic to expect that the model will accurately predict the surface conditions at a specific point in space at the exact same time. The model is a regional-scale model that is skilled at computing the fluid dynamics of general synoptic-scale atmospheric circulations and predicting phenomena such as sea breezes, land breezes, large scale terrain affected flows and temperatures based on variable synoptic inputs, terrain, soil type and land use influences.

To evaluate the model's ability to predict the correct wind direction for each hour of the day, wind speed must be included in the analysis. Consequently, the entire wind field is broken down into its vector components, U and V.

1.2 Correlation statistics for observed and predicted meteorology

Balch (2009) summarised the following statistical approach for the evaluation of meteorological model performance based on the methods described by Chang and Hanna (2005) and Wilmott (1982).

Root mean square error (RMSE)

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}$$

Where:

N = number of observed and predicted hours in analysis (i.e. one year)
P = hourly prediction
O = hourly observation

The RSME can be described as the standard deviation of the difference for hourly predicted and observed pairings at a specific point. The RMSE is a quadratic scoring rule, which measures the average magnitude of the error. The difference between predicted and corresponding observed values are each squared and then averaged over the sample. Finally, the square root of the average is taken. Since the errors are squared before they are averaged, the RMSE gives a relatively high weight to large errors. This means the RMSE is most useful when large errors are particularly undesirable. Overall, the RSME is a good overall measure of model performance, but since large errors are weighted heavily (due to squaring), its value can be distorted. RMSE is equal to the unit of the values being analysed i.e., an RMSE of 1.2 for wind speed = 1.2 m/s.

Systematic root mean square error ($RMSE_s$)

$$\mathrm{RMSE_S} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\hat{P}_i - O_i)^2}$$

Where:

N = number of observed and predicted hours in analysis (i.e. one year)
$\hat{P}$ = mean of predictions
O = hourly observation

The $RMSE_s$ is calculated as the square root of the mean square difference of hourly predictions from the regression formula and observation pairings, at a specific point. The regressed predictions are taken from the least squares formula. The $RMSE_s$ estimates the model's linear (or systematic) error. The systematic error is a measure of the bias in the model due to user input or model deficiency, i.e., data input errors, assimilation variables, and choice of model options. The $RMSE_s$ is a metric for the model's accuracy.

Unsystematic root mean square error ($RMSE_U$)

$$\mathrm{RMSE}_{\mathrm{U}} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\hat{P}_i - P_i)^2}$$

Where:

N = number of observed and predicted hours in analysis (i.e. one year)
$\hat{P}$ = mean of predictions
O = hourly prediction

The $RMSE_u$ is calculated as the square root of the mean square difference of hourly predictions from the regression formula and model prediction value pairings, at a specific point. The $RMSE_u$ is a measure of how much of the difference between predictions and observations result from random processes or influences outside the legitimate range of the model. This error may require model refinement, such as new algorithms or higher resolution grids, or that the phenomena being simulated cannot be fully resolved by the model. The $RMSE_u$ is a metric for the model's precision.

Ultimately, for good model performance, the RMSE should be a low value, with most of the variation explained in the observations. Here, the systematic error $RMSE_s$ should approach zero and the unsystematic error, $RMSE_u$, should approach the RMSE since:

$$\mathrm{RMSE}^2 = \mathrm{RMSE}_{\mathrm{S}}^2 + \mathrm{RMSE}_{\mathrm{u}}^2$$

Mean error and mean absolute error

The Mean Error (ME) is simply the average of the hourly modelled values minus the hourly observed values. It contains both systematic and unsystematic errors and is heavily influence by high and low errors.

The Mean Absolute Error (MAE) measures the average magnitude of the errors in a set of predictions, without considering their direction. It measures accuracy for continuous variables. Expressed in words, the MAE is the average of the absolute values of the differences between predictions and the corresponding observation. The MAE is a linear score, which means that all the individual differences are weighted equally in the average. The MAE and the RMSE can be used together to diagnose the variation in the errors in a set of predictions. The RMSE will always be larger or equal to the MAE; the greater difference between them, the greater the variance in the individual errors in the sample. If the RMSE = MAE, then all the errors are of the same magnitude. Both the MAE and RMSE can range from 0 to ∞. They are negatively-oriented scores, i.e., lower values are better.

Index of agreement

The Index of Agreement (IOA) is defined as:

$$\mathrm{IOA} = 1 - \frac{\sum_{i=1}^{N}(P_i - O_i)^2}{\sum_{i=1}^{N}(|P_i - O_{mean}| + |O_i - O_{mean}|)^2}$$

The IOA is calculated using a method described in Willmott (1982). The IOA can take a value between 0 and 1, with 1 indicating perfect agreement. The IOA is the ratio of the total RMSE to the sum of two differences, i.e., the difference between each prediction and the observed mean, and the difference between each observation and observed mean. From another perspective, the IOA is a measure of the match between the departure of each prediction from the observed mean and the departure of each observation from the observed mean. A value of 0.5 is considered acceptable and >0.6 is considered good performance for time and space predictions.

Where:

N is the number of observations,

P_i are the hourly model predictions,

O_i are the hourly observations,

O_{mean} is the observed observation mean, and $\hat{P}_i = a + bO_i$ is the linear regression fitted with intercepts a and slope b.

Skill measures

Skill measure statistics are given in terms of a score, rather than in absolute terms. A model's skill can be measured by the difference in the standard deviation of the modelled and observed values (Chang and Hanna, 2004).

The **Skill_E (se)** is indicative of how much of the standard deviation in the observations is predicted to be due to random/natural processes (unsystematic) in the atmospheric boundary layer. i.e., turbulence/chaos. For good model performance, the value for Skill_E should be less than one, i.e.:

SKILL_E = (RMSE_U/ STDEV OBS) < 1 shows skill

Skill_V (sv) is ratio of the standard deviation of the model predictions to the standard deviation of the observations. For good model performance, the value for Skill_V should be close to one, i.e.:

SKILL_V = (STDEV_MOD/ STDEV _OBS) close to 1 shows skill

Skill_R (sr) takes into account systematic and unsystematic errors in relation to the observed standard deviation. For good model performance, the value for Skill_E should be less than one, i.e.:

SKILL_R = (RMSE/ STDEV _OBS) < 1 shows skill

2 Model Performance Evaluation

A comparison of TAPM predicted and observed meteorology is presented in this section. The wind rose diagrams for the TAPM predicted and AWS observed wind distributions are presented in Figure 2-1. The winds are based on observations and model predictions at the location of the BOM Ballina Aero AWS.

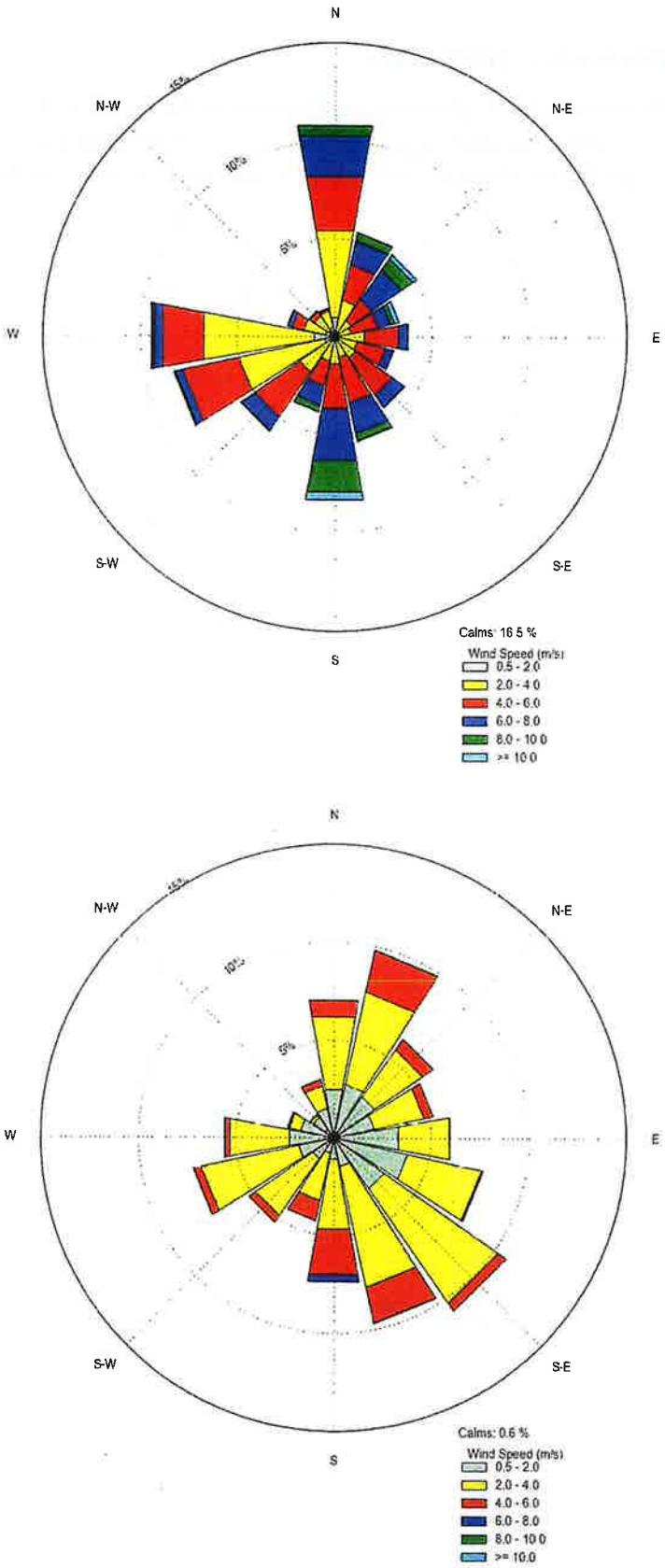

Figure 2-1 Distribution of observed (top) and TAPM predicted (bottom) winds at Ballina Aero

The comparison of the distributions of meteorological variables is presented as probability density function plots and QQ (quantile-quantile) plots for wind speed, wind direction, temperature, relative humidity, the vector U wind and vector V wind components in Figure 2-2 to Figure 2-9, respectively. The shaded region shown in the QQ plot cover the ± 50% acceptable range of model performance.

The staggered steps shown in the QQ plots are due to the calibration of the AWS equipment, wherein data are stored with less significant figures than what the model predicts.

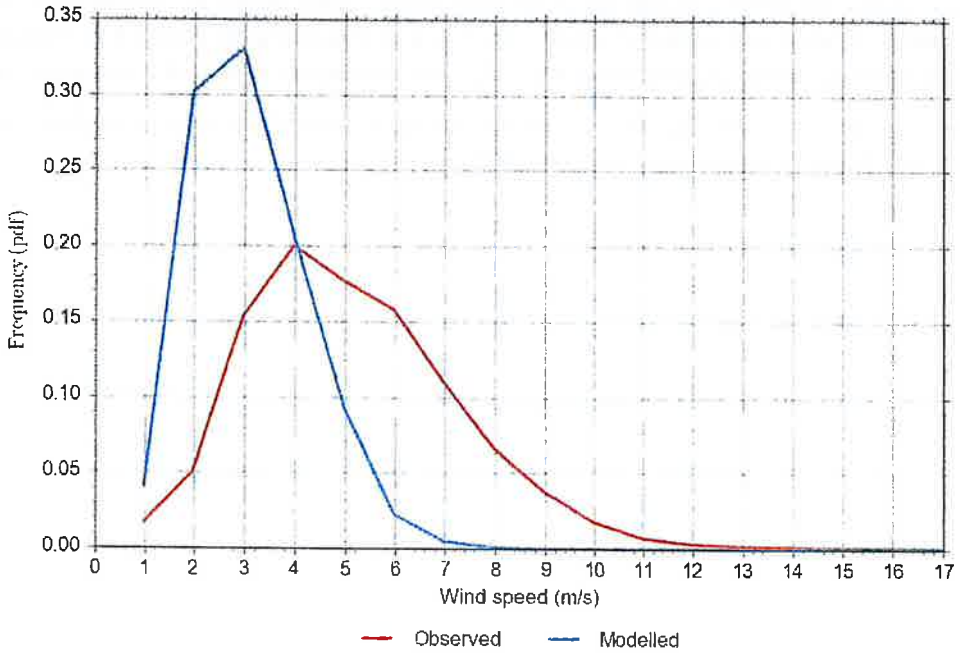

Figure 2-2 Frequency distributions of observed versus TAPM predicted (modelled) wind speed

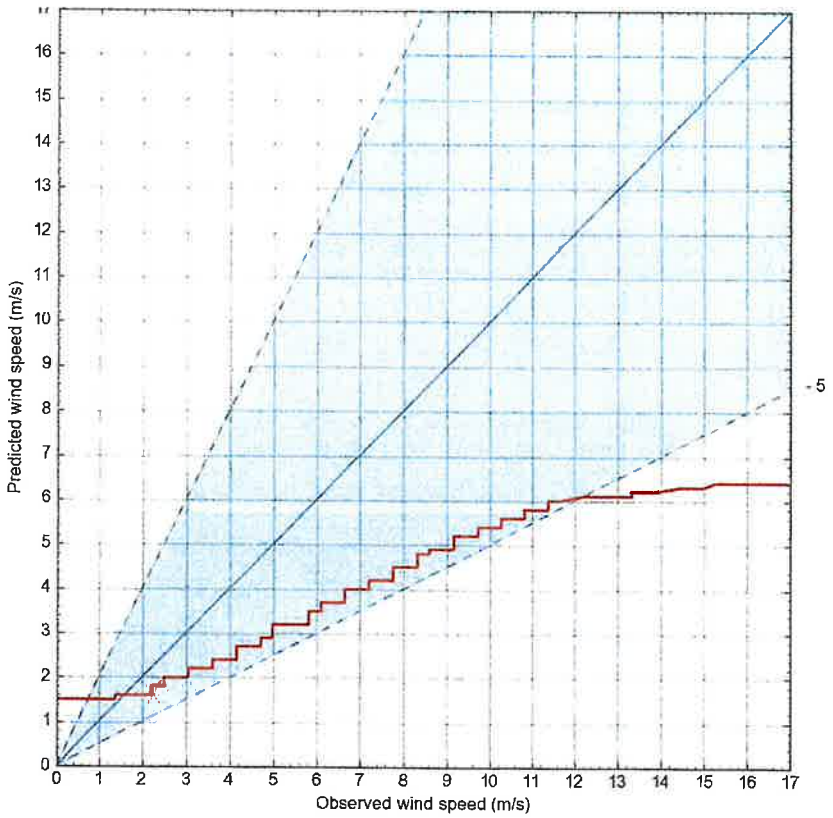

Figure 2-3 Quantile-quantile plot relationship between observed and TAPM predicted (modelled) wind speed

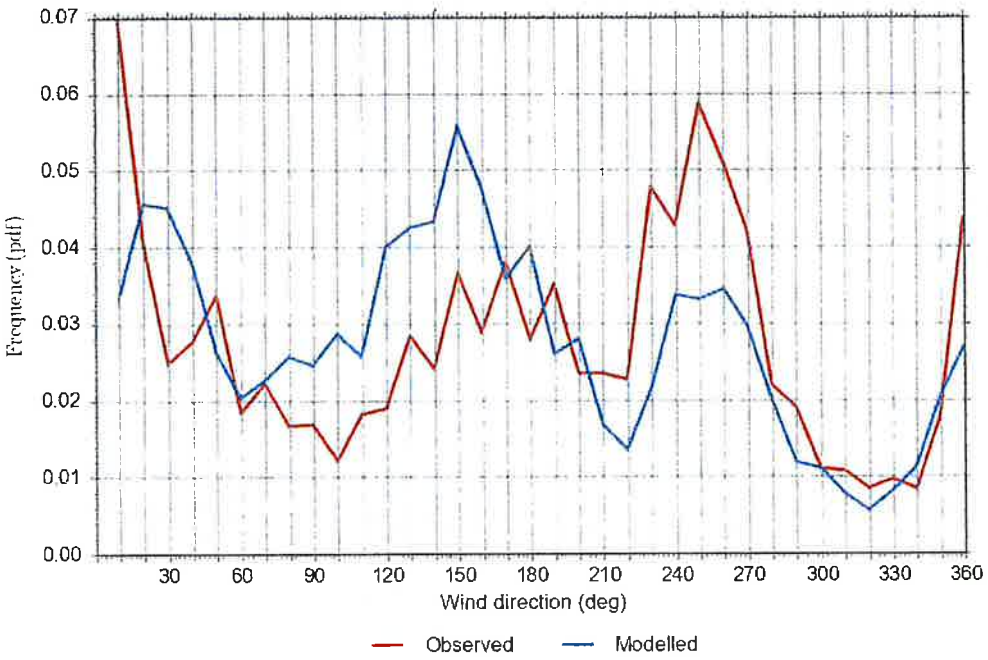

Figure 2-4 Frequency distributions of observed versus TAPM predicted (modelled) wind direction

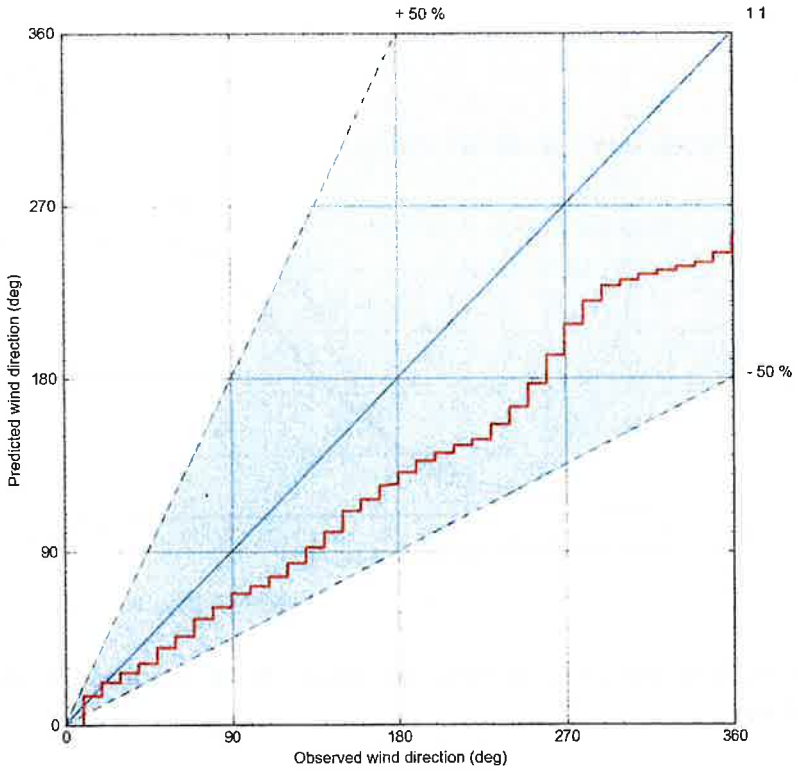

Figure 2-5 Quantile-quantile plot relationship between observed and TAPM predicted (modelled) wind direction

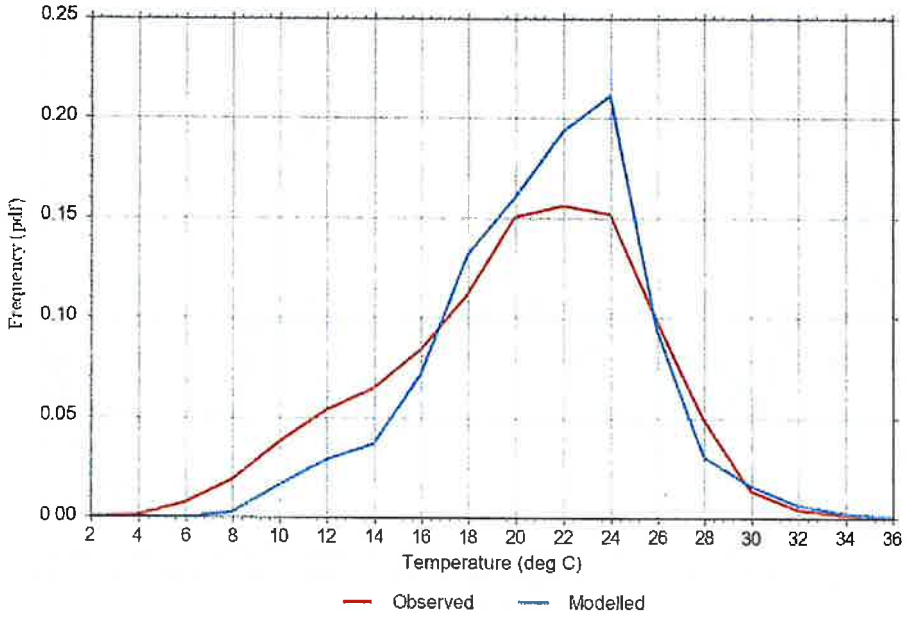

Figure 2-6 Frequency distributions of observed versus TAPM predicted (modelled) surface air temperatures

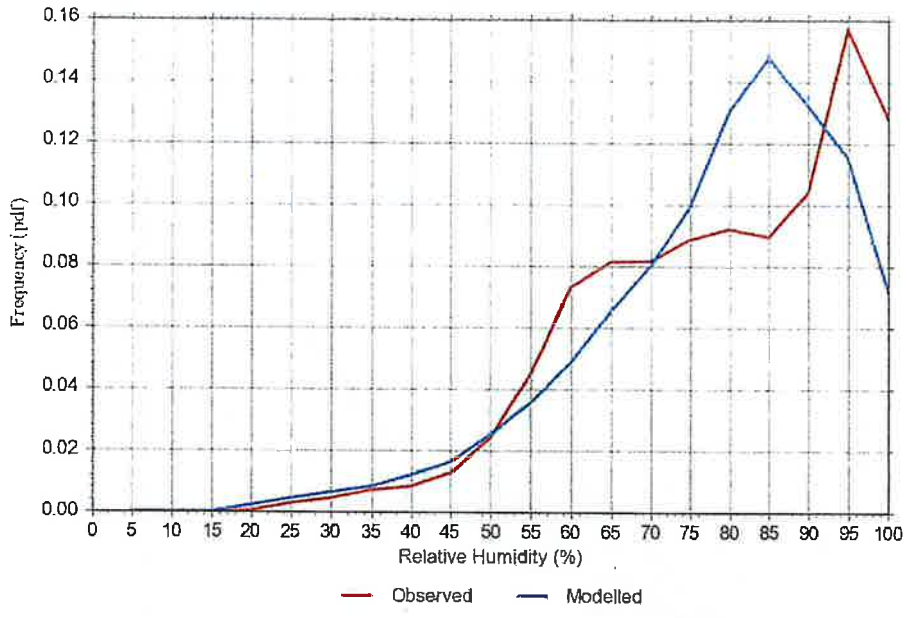

Figure 2-7 Frequency distributions of observed versus TAPM predicted (modelled) relative humidity

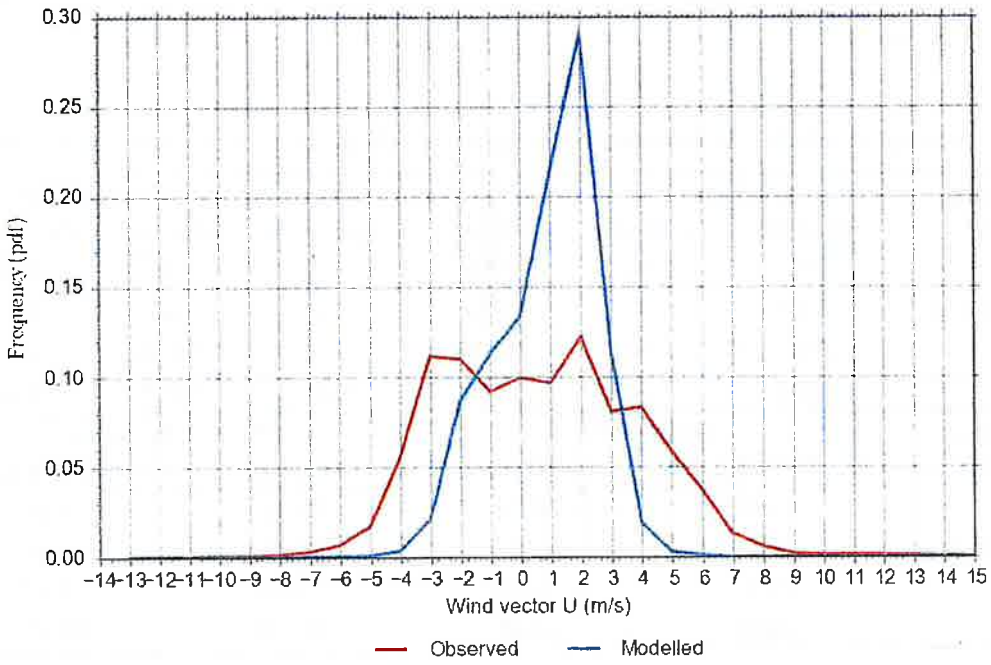

Figure 2-8 Frequency distributions of observed versus TAPM predicted (modelled) wind vector component U

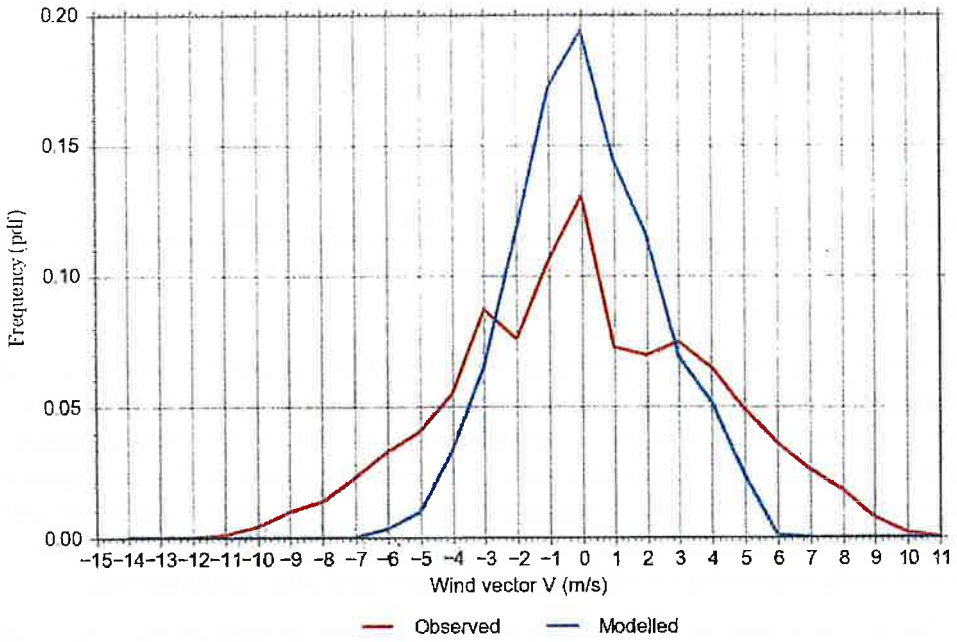

Figure 2-9 Frequency distributions of observed versus TAPM predicted (modelled) wind vector component V

Descriptive statistics for the modelled and observed winds are presented in Table 2-1. Correlation statistics for the performance of TAPM when compared to the observations at Ballina Aero AWS are summarised in Table 2-2.

Table 2-1 Descriptive statistics for meteorological observations and TAPM model predictions

Descriptive Statistics	Wind speed		U Vector wind		V Vector wind	
	AWS OBS	TAPM MOD	AWS OBS	TAPM MOD	AWS OBS	TAPM MOD
Average	3.83	2.55	0.13	0.36	-0.48	-0.39
Standard deviation	2.60	1.12	3.20	1.66	3.90	2.17
Minimum	0.00	0.10	-13.33	-7.28	-14.23	-6.45
Maximum	16.94	7.30	14.67	5.38	10.18	5.40

Descriptive Statistics	Temperature		Relative Humidity	
	AWS OBS	TAPM MOD	AWS OBS	TAPM MOD
Average	19.07	20.10	77.19	75.75
Standard deviation	5.19	4.19	16.38	15.81
Minimum	3.40	6.70	19.00	15.50
Maximum	33.40	35.20	102.00	100.00

Table 2-2 Correlation statistics for TAPM meteorological model performance

Statistics	Wind speed	U vector wind	V vector wind	Temp	Relative Humidity
Root Mean Square Error	2.37	2.40	2.38	2.45	12.29
Systematic Root Mean Square Error	2.23	2.06	1.99	1.72	5.30
Unsystematic Root Mean Square Error	0.81	1.23	1.31	1.74	11.08
Index of Agreement	0.65	0.75	0.84	0.93	0.84
$Skill_e$	0.31	0.39	0.33	0.34	0.68
$Skill_v$	0.43	0.52	0.56	0.81	0.97
$Skill_r$	0.91	0.75	0.61	0.47	0.75
Mean Absolute Error	1.94	1.89	1.86	1.84	9.25

The data indicates the following:

- TAPM significantly over-predicts the frequency of light winds in the 1 – 3 m/s range. This is a common finding with TAPM v4. Adjustments to the model's algorithms were made for the version 4 upgrade, as TAPM v3's under-estimation of light winds were considered to be problematic for modelling fugitive emissions (commonly odour emissions), that typically cause impacts under light wind, stable atmospheric conditions. The over-prediction of light winds provides for a conservative assessment of ground level fugitive and wake-affected stack emissions, likely to generate the highest impacts under light wind, stable conditions.
- TAPM has overpredicted the southeasterly winds and underpredicted the northerly winds.
- TAPM performs reasonably well in predicting surface air temperatures.
- TAPM performs reasonably well in predicting relative humidity.
- TAPM performs reasonably well in predicting the general shape of the distributions of the U and V vector wind components. The model predicts a narrower range of values, showing higher

frequencies of lower U and V components compared to the wider range but more well distributed frequencies of U and V components derived from observations.

- There may be slight inconsistencies in the predicted data due to localised obstacles, terrain and/or drainage flow effects that are not easily resolved by the regional-scale (1 kilometre resolution) of the meteorological model. This will be more pronounced in coastal sites like Ballina Aero AWS.
- There may be some inconsistencies in the AWS data when comparing it to the modelled data, where the AWS data is recorded in 10° wind direction segments. This feature is also likely to influence the accuracy of the data correlations.

The correlation statistics indicate the following:

- The RMSE and MAE statistics indicate reasonable model performance. However, as discussed in Section 1.1, it is not expected that TAPM will predict the exact wind speed and direction in time and space.
- Notwithstanding the preceding point, all IOA values are >0.65, which indicates good model performance for time and space pairings. An IOA greater than 0.5 is considered to be acceptable for modelling purposes.
- $Skill_e$, $Skill_{v,\ and}$ $Skill_r$ values for temperature, wind direction, and relative humidity indicate good model performance. This is also supported in a comparison of the basic statistics of observations and model predictions for these variables.
- $Skill_e$ and $Skill_v$ values are lower for wind speed and the individual U and V components, which suggest that the model overestimates the frequency of lighter wind speeds. This is also illustrated in the PDF plots.

3 Conclusion

The meteorological model evaluation indicates that TAPM has performed well in predicting the regional flows and the distributions of each meteorological parameter, and that the statistical scores are generally within the range expected of a good dispersion model.

Some of the anomalies and inconsistencies (i.e. overprediction of light wind speeds) is a common finding with the model. Notwithstanding this, the over-prediction of light winds provides for a conservative assessment of ground level fugitive and wake-affected stack emissions, likely to generate the highest impacts under light wind, stable conditions.

Furthermore, TAPM has performed reasonably well in predicting wind direction, temperature, and relative humidity.

The model performance evaluation shows that the meteorological dataset generated by TAPM is suitable for use in the modelling study.

Appendix D
Example CALPUFF Dispersion Model Input File

The CALPUFF input file presented here represents odour emissions emitted from the Kiln Dryer stack.

```
CALPUFF.INP     7.0          Generated by CALPUFF View 8.4.0 - 21/09/2017
Boral Alstonville, NSW
Dryer Stack (Odour)
Plant Operating All Hours
---------- Run title (3 lines) ------------------------------------------
               CALPUFF MODEL CONTROL FILE
               --------------------------
------------------------------------------------------------------------------
INPUT GROUP: 0 -- Input and Output File Names
-------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT = *
   or
ISCMET.DAT    input    * ISCDAT = *
   or
PLMMET.DAT    input    * PLMDAT = *
   or
PROFILE.DAT   input    * PRFDAT = *
SURFACE.DAT   input    * SFCDAT = *
RESTARTB.DAT  input    * RSTARTB = *
------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST = CALPUFF.LST !
CONC.DAT      output   ! CONDAT = CONC.DAT !
DFLX.DAT      output   ! DFDAT = DFLX.DAT !
WFLX.DAT      output   ! WFDAT = WFLX.DAT !
VISB.DAT      output   * VISDAT = *
TK2D.DAT      output   * T2DDAT = *
RHO2D.DAT     output   * RHODAT = *
RESTARTE.DAT  output   * RSTARTE = *
------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT = *
VD.DAT        input    * VDDAT = *
CHEM.DAT      input    * CHEMDAT = *
AUX           input    * AUXEXT = *
(Extension added to METDAT filename(s) for files
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT = *
NH3Z.DAT      input    * NH3ZDAT = *
HILL.DAT      input    * HILDAT = *
HILLRCT.DAT   input    * RCTDAT = *
COASTLN.DAT   input    * CSTDAT = *
FLUXBDY.DAT   input    * BDYDAT = *
BCON.DAT      input    * BCNDAT = *
DEBUG.DAT     output   * DEBUG = *
MASSFLX.DAT   output   * FLXDAT = *
MASSBAL.DAT   output   * BALDAT = *
FOG.DAT       output   * FOGDAT = *
RISE.DAT      output   * RISDAT = *
PFTRAK.DAT    output   * TRKDAT = *
------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
      T = lower case      ! LCFILES = F !
      F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in length

Provision for multiple input files
----------------------------------
   Number of CALMET.DAT Domains (NMETDOM)
                        Default: 1      ! NMETDOM = 1 !
   Number of CALMET.DAT files (NMETDAT)
   (Total for ALL Domains)
                        Default: 1      ! NMETDAT = 12 !
   Number of PTEMARB.DAT files for run (NPTDAT)
                        Default: 0      ! NPTDAT = 0 !
   Number of BAEMARB.DAT files for run (NARDAT)
                        Default: 0      ! NARDAT = 0 !
   Number of VOLEMARB.DAT files for run (NVOLDAT)
                        Default: 0      ! NVOLDAT = 0 !
   Number of FLARE source files (FLEMARB.DAT)
   with time-varying data (NFLDAT)
                        Default: 0      ! NFLDAT = 0 !
   Number of ROAD source files (RDEMARB.DAT)
   with time-varying data (NRDDAT)
                        Default: 0      ! NRDDAT = 0 !
   Number of BUOYANT LINE source files (LNEMARB.DAT)
   with time-varying data (NLNDAT)
                        Default: 0      ! NLNDAT = 0 !
   Note:  Only 1 BUOYANT LINE source file is allowed
   -----

!END!
```

```
------------
Subgroup (0a)
------------
 Provide a name for each CALMET domain if NMETDOM > 1
 Enter NMETDOM lines.
                          a,b
Default Name          Domain Name
------------          ------------
* DOMAINLIST = *

 The following CALMET.DAT filenames are processed in sequence
 if NMETDAT > 1
 Enter NMETDAT lines, 1 line for each file name.
                            a,c,d
Default Name  Type        File Name
------------  ----        ---------
 none         input   ! METDAT=..\..\CALMET\201203\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201204\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201205\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201206\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201207\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201208\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201209\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201210\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201211\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201212\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201301\CALMET.DAT    ! !END!
 none         input   ! METDAT=..\..\CALMET\201302\CALMET.DAT    ! !END!
------------
   a
    The name for each CALMET domain and each CALMET.DAT file is treated
    as a separate input subgroup and therefore must end with an input
    group terminator.
   b
    Use DOMAIN1= to assign the name for the outermost CALMET domain.
    Use DOMAIN2= to assign the name for the next inner CALMET domain.
    Use DOMAIN3= to assign the name for the next inner CALMET domain, etc.
     ------------------------------------------------------------
     | When inner domains with equal resolution (grid-cell size)  |
     | overlap, the data from the FIRST such domain in the list will |
     | be used if all other criteria for choosing the controlling  |
     | grid domain are inconclusive.                               |
     ------------------------------------------------------------
   c
    Use METDAT1= to assign the file names for the outermost CALMET domain.
    Use METDAT2= to assign the file names for the next inner CALMET domain.
    Use METDAT3= to assign the file names for the next inner CALMET domain, etc.
   d
    The filenames for each domain must be provided in sequential order

------------
Subgroup (0b) – PTEMARB.DAT files
------------
 POINT Source File Names
 The following PTEMARB.DAT filenames are processed if NPTDAT>0
 A total of NPTDAT lines is expected with one file name assigned per line
 Each line is treated as an input group and must terminate with END
 (surrounded by delimiters)
 (Each file contains emissions parameters for the entire period modeled
  for 1 or more sources)
Default Name  Type        File Name
------------  ----        ---------
* PTDATLIST = *

------------
Subgroup (0c) – BAEMARB.DAT files
------------
 BUOYANT AREA Source File Names
 The following BAEMARB.DAT filenames are processed if NARDAT>0
 A total of NARDAT lines is expected with one file name assigned per line
 Each line is treated as an input group and must terminate with END
 (surrounded by delimiters)
 (Each file contains emissions parameters for the entire period modeled
  for 1 or more sources)
Default Name  Type        File Name
------------  ----        ---------
* ARDATLIST = *

------------
Subgroup (0d) – VOLEMARB.DAT files
------------
 VOLUME Source File Names
 The following VOLEMARB.DAT filenames are processed if NVOLDAT>0
 A total of NVOLDAT lines is expected with one file name assigned per line
 Each line is treated as an input group and must terminate with END
 (surrounded by delimiters)
 (Each file contains emissions parameters for the entire period modeled
```

```
 for 1 or more sources)
Default Name  Type          File Name
------------ ----          ----------
* VOLDATLIST = *
-------------
Subgroup (0e) -- FLEMARB.DAT files
-------------
 FLARE Source File Names
 The following FLEMARB.DAT filenames are processed if NFLDAT>0
 A total of NFLDAT lines is expected with one file name assigned per line
 Each line is treated as an input group and must terminate with END
 (surrounded by delimiters)
 (Each file contains emissions parameters for the entire period modeled
  for 1 or more sources)
Default Name  Type          File Name
------------ ----          ----------
* FLEMARBLIST = *

-------------
Subgroup (0f) -- RDEMARB.DAT files
-------------
 ROAD Source File Names
 The following RDEMARB.DAT filenames are processed if NRDDAT>0
 A total of NRDDAT lines is expected with one file name assigned per line
 Each line is treated as an input group and must terminate with END
 (surrounded by delimiters)
 (Each file contains emissions parameters for the entire period modeled
  for 1 or more sources)
Default Name  Type          File Name
------------ ----          ----------
* RDEMARBLIST = *

-------------
Subgroup (0g) -- LNEMARB.DAT file
-------------
 BUOYANT LINE Source File Name  (not more than 1)
 The following LNEMARB.DAT filename is processed if NLNDAT>0
 The assignment is treated as an input group and must terminate with END
 (surrounded by delimiters)
Default Name  Type          File Name
------------ ----          ----------
* LNEMARBLIST = *
-----------------------------------------------------------------------------
INPUT GROUP: 1 -- General run control parameters
-------------
   Option to run all periods found
   in the met. file    (METRUN)  Default: 0      ! METRUN = 0 !
      METRUN = 0 - Run period explicitly defined below
      METRUN = 1 - Run all periods in met. file
   Starting date:   Year  (IBYR) --   No default   ! IBYR = 2012 !
                    Month (IBMO) --   No default   ! IBMO = 3 !
                    Day   (IBDY) --   No default   ! IBDY = 1 !
   Starting time:   Hour  (IBHR) --   No default   ! IBHR = 0 !
                    Minute (IBMIN) --  No default   ! IBMIN = 0 !
                    Second (IBSEC) --  No default   ! IBSEC = 0 !
   Ending date:     Year  (IEYR) --   No default   ! IEYR = 2013 !
                    Month (IEMO) --   No default   ! IEMO = 2 !
                    Day   (IEDY) --   No default   ! IEDY = 28 !
   Ending time:     Hour  (IEHR) --   No default   ! IEHR = 23 !
                    Minute (IEMIN) --  No default   ! IEMIN = 0 !
                    Second (IESEC) --  No default   ! IESEC = 0 !
   (These are only used if METRUN = 0)
   Base time zone:          (ABTZ) --   No default   ! ABTZ = UTC+1000 !
    (character*8)
   The modeling domain may span multiple time zones.  ABTZ defines the
   base time zone used for the entire simulation.  This must match the
   base time zone of the meteorological data.
   Examples:
      Greenwich Mean Time (GMT) = UTC+0000
      EST                  = UTC-0500
      CST                  = UTC-0600
      MST                  = UTC-0700
      PST                  = UTC-0800
      Los Angeles, USA        = UTC-0800
      New York, USA           = UTC-0500
      Santiago, Chile         = UTC-0400
      UK                   = UTC+0000
      Western Europe          = UTC+0100
      Rome, Italy             = UTC+0100
      Cape Town, S.Africa     = UTC+0200
      Sydney, Australia       = UTC+1000

   Length of modeling time-step (seconds)
   Equal to update period in the primary
   meteorological data files, or an
   integer fraction of it (1/2, 1/3 ...)
   Must be no larger than 1 hour
```

```
   (NSECDT)                Default:3600    ! NSECDT = 3600 !
                           Units: seconds
   Number of chemical species (NSPEC)
                           Default: 5      ! NSPEC = 1 !
   Number of chemical species
   to be emitted  (NSE)    Default: 3      ! NSE = 1 !
   Flag to stop run after
   SETUP phase (ITEST)     Default: 2      ! ITEST = 2 !
   (Used to allow checking
   of the model inputs, files, etc.)
       ITEST = 1 - STOPS program after SETUP phase
       ITEST = 2 - Continues with execution of program
                   after SETUP
   Restart Configuration:
     Control flag (MRESTART)   Default: 0      ! MRESTART = 0 !
       0 = Do not read or write a restart file
       1 = Read a restart file at the beginning of
           the run
       2 = Write a restart file during run
       3 = Read a restart file at beginning of run
           and write a restart file during run
     Number of periods in Restart
     output cycle (NRESPD)     Default: 0      ! NRESPD = 0 !
       0 = File written only at last period
      >0 = File updated every NRESPD periods
   Meteorological Data Format (METFM)
                           Default: 1      ! METFM = 1 !
       METFM = 1 - CALMET binary file (CALMET.MET)
       METFM = 2 - ISC ASCII file (ISCMET.MET)
       METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
       METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                   surface parameters file (SURFACE.DAT)
       METFM = 5 - AERMET tower file (PROFILE.DAT) and
                   surface parameters file (SURFACE.DAT)
   Meteorological Profile Data Format (MPRFFM)
        (used only for METFM = 1, 2, 3)
                           Default: 1      ! MPRFFM = 1 !
       MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
       MPRFFM = 2 - AERMET tower file (PROFILE.DAT)
   Sigma-y is adjusted by the factor (AVET/PGTIME)**0.2 to either
   decrease it if the averaging time selected is less than the base
   averaging time, or increase it if the averaging time is greater.
   The base averaging time is denoted as PGTIME due to historical
   reasons as this adjustment was originally applied to the PG sigma
   option.  It is now applied to all dispersion options.
   The factor is applied to the ambient turbulence sigma-v (m/s) and
   does not alter buoyancy enhancement or far-field Heffter growth.

   Averaging Time (minutes) (AVET)
                           Default: 60.0   ! AVET = 60 !
   Base Averaging Time (minutes) (PGTIME)
                           Default: 60.0   ! PGTIME = 60 !
   Output units for binary concentration and flux files
   written in Dataset v2.2 or later formats
   (IOUTU)                 Default: 1      ! IOUTU = 2 !
      1 = mass     - g/m3 (conc) or g/m2/s (dep)
      2 = odour    - odour_units (conc)
      3 = radiation - Bq/m3 (conc) or Bq/m2/s (dep)
!END!

----------
INPUT GROUP: 2 – Technical options
----------

   Vertical distribution used in the
   near field (MGAUSS)             Default: 1    ! MGAUSS = 1 !
     0 = uniform
     1 = Gaussian
   Terrain adjustment method
   (MCTADJ)                Default: 3    ! MCTADJ = 3 !
     0 = no adjustment
     1 = ISC-type of terrain adjustment
     2 = simple, CALPUFF-type of terrain
         adjustment
     3 = partial plume path adjustment
   Subgrid-scale complex terrain
   flag (MCTSG)            Default: 0    ! MCTSG = 0 !
     0 = not modeled
     1 = modeled
   Near-field puffs modeled as
   elongated slugs? (MSLUG)        Default: 0    ! MSLUG = 0 !
     0 = no
     1 = yes (slug model used)
   Transitional plume rise modeled?
   (MTRANS)                Default: 1    ! MTRANS = 1 !
     0 = no  (i.e., final rise only)
     1 = yes (i.e., transitional rise computed)
```

```
Stack tip downwash? (MTIP)          Default: 1    ! MTIP = 1 !
  0 = no  (i.e., no stack tip downwash)
  1 = yes (i.e., use stack tip downwash)
Method used to compute plume rise for
point sources not subject to building
downwash? (MRISE)                   Default: 1    ! MRISE = 1 !
  1 = Briggs plume rise
  2 = Numerical plume rise
Apply stack-tip downwash to FLARE sources?
(MTIP_FL)                           Default: 0    ! MTIP_FL = 0 !
  0 = no  (no stack-tip downwash)
  1 = yes (apply stack-tip downwash)
Plume rise module for FLARE sources
(MRISE_FL)                          Default: 2    ! MRISE_FL = 2 !
  1 = Briggs module
  2 = Numerical rise module

Method used to simulate building
downwash? (MBDW)                    Default: 1    ! MBDW = 2 !
  1 = ISC method
  2 = PRIME method
Vertical wind shear modeled above
stack top? (MSHEAR)                 Default: 0    ! MSHEAR = 0 !
  0 = no  (i.e., vertical wind shear not modeled)
  1 = yes (i.e., vertical wind shear modeled)
Puff splitting allowed? (MSPLIT)    Default: 0    ! MSPLIT = 0 !
  0 = no (i.e., puffs not split)
  1 = yes (i.e., puffs are split)
Chemical mechanism flag (MCHEM)     Default: 1    ! MCHEM = 0 !
  0 = chemical transformation not
      modeled
  1 = transformation rates computed
      internally (MESOPUFF II scheme)
  2 = user-specified transformation
      rates used
  3 = transformation rates computed
      internally (RIVAD/ARM3 scheme)
  4 = secondary organic aerosol formation
      computed (MESOPUFF II scheme for OH)
  5 = user-specified half-life with or
      without transfer to child species
  6 = transformation rates computed
      internally (Updated RIVAD scheme with
      ISORROPIA equilibrium)
  7 = transformation rates computed
      internally (Updated RIVAD scheme with
      ISORROPIA equilibrium and CalTech SOA)
Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 6, or 7)      Default: 0    ! MAQCHEM = 0 !
  0 = aqueous phase transformation
      not modeled
  1 = transformation rates and wet
      scavenging coefficients adjusted
      for in-cloud aqueous phase reactions
      (adapted from RADM cloud model
       implementation in CMAQ/SCICHEM)
Liquid Water Content flag (MLWC)
(Used only if MAQCHEM = 1)          Default: 1    ! MLWC = 1 !
  0 = water content estimated from cloud cover
      and presence of precipitation
  1 = gridded cloud water data read from CALMET
      water content output files (filenames are
      the CALMET.DAT names PLUS the extension
      AUXEXT provided in Input Group 0)
Wet removal modeled ? (MWET)        Default: 1    ! MWET = 0 !
  0 = no
  1 = yes
Dry deposition modeled ? (MDRY)     Default: 1    ! MDRY = 0 !
  0 = no
  1 = yes
  (dry deposition method specified
   for each species in Input Group 3)

Gravitational settling (plume tilt)
modeled ? (MTILT)                   Default: 0    ! MTILT = 0 !
  0 = no
  1 = yes
  (puff center falls at the gravitational
   settling velocity for 1 particle species)
Restrictions:
  - MDRY  = 1
  - NSPEC = 1  (must be particle species as well)
  - sg    = 0  GEOMETRIC STANDARD DEVIATION in Group 8 is
               set to zero for a single particle diameter
Method used to compute dispersion
coefficients (MDISP)                Default: 3    ! MDISP = 3 !
  1 = dispersion coefficients computed from measured values
```

```
    of turbulence, sigma v, sigma w
  2 = dispersion coefficients from internally calculated
    sigma v, sigma w using micrometeorological variables
    (u*, w*, L, etc.)
  3 = PG dispersion coefficients for RURAL areas (computed using
    the ISCST multi-segment approximation) and MP coefficients in
    urban areas
  4 = same as 3 except PG coefficients computed using
    the MESOPUFF II eqns.
  5 = CTDM sigmas used for stable and neutral conditions.
    For unstable conditions, sigmas are computed as in
    MDISP = 3, described above.  MDISP = 5 assumes that
    measured values are read
Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)        Default: 3    ! MTURBVW = 3 !
  1 = use sigma-v or sigma-theta measurements
    from PROFILE.DAT to compute sigma-y
    (valid for METFM = 1, 2, 3, 4, 5)
  2 = use sigma-w measurements
    from PROFILE.DAT to compute sigma-z
    (valid for METFM = 1, 2, 3, 4, 5)
  3 = use both sigma-(v/theta) and sigma-w
    from PROFILE.DAT to compute sigma-y and sigma-z
    (valid for METFM = 1, 2, 3, 4, 5)
  4 = use sigma-theta measurements
    from PLMMET.DAT to compute sigma-y
    (valid only if METFM = 3)
Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                     Default: 3    ! MDISP2 = 3 !
(used only if MDISP = 1 or 5)
  2 = dispersion coefficients from internally calculated
    sigma v, sigma w using micrometeorological variables
    (u*, w*, L, etc.)
  3 = PG dispersion coefficients for RURAL areas (computed using
    the ISCST multi-segment approximation) and MP coefficients in
    urban areas
  4 = same as 3 except PG coefficients computed using
    the MESOPUFF II eqns.
[DIAGNOSTIC FEATURE]
Method used for Lagrangian timescale for Sigma-y
(used only if MDISP=1,2 or MDISP2=1,2)
(MTAULY)                             Default: 0    ! MTAULY = 0 !
  0 = Draxler default 617.284 (s)
  1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
 10 <Direct user input (s)           -- e.g., 306.9

[DIAGNOSTIC FEATURE]
Method used for Advective Decay timescale for Turbulence
(used only if MDISP=2 or MDISP2=2)
(MTAUADV)                            Default: 0    ! MTAUADV = 0 !
  0 = No turbulence advection
  1 = Computed (OPTION NOT IMPLEMENTED)
 10 <Direct user input (s)   -- e.g., 800

Method used to compute turbulence sigma-v &
sigma-w using micrometeorological variables
(Used only if MDISP = 2 or MDISP2 = 2)
(MCTURB)                             Default: 1    ! MCTURB = 1 !
  1 = Standard CALPUFF subroutines
  2 = AERMOD subroutines
PG sigma-y,z adj. for roughness?     Default: 0    ! MROUGH = 0 !
(MROUGH)
  0 = no
  1 = yes
Partial plume penetration of         Default: 1    ! MPARTL = 1 !
elevated inversion modeled for
point sources?
(MPARTL)
  0 = no
  1 = yes
Partial plume penetration of         Default: 1    ! MPARTLBA = 0 !
elevated inversion modeled for
buoyant area sources?
(MPARTLBA)
  0 = no
  1 = yes
Strength of temperature inversion    Default: 0    ! MTINV = 0 !
provided in PROFILE.DAT extended records?
(MTINV)
  0 = no (computed from measured/default gradients)
  1 = yes
PDF used for dispersion under convective conditions?
                                     Default: 0    ! MPDF = 0 !
(MPDF)
  0 = no
  1 = yes
```

```
Sub-Grid TIBL module used for shore line?
                        Default: 0    ! MSGTIBL = 0 !
(MSGTIBL)
  0 = no
  1 = yes
Boundary conditions (concentration) modeled?
                        Default: 0    ! MBCON = 0 !
(MBCON)
  0 = no
  1 = yes, using formatted BCON.DAT file
  2 = yes, using unformatted CONC.DAT file
Note:  MBCON > 0 requires that the last species modeled
     be 'BCON'.  Mass is placed in species BCON when
     generating boundary condition puffs so that clean
     air entering the modeling domain can be simulated
     in the same way as polluted air.  Specify zero
     emission of species BCON for all regular sources.
Individual source contributions saved?
                        Default: 0    ! MSOURCE = 0 !
(MSOURCE)
  0 = no
  1 = yes

Analyses of fogging and icing impacts due to emissions from
arrays of mechanically-forced cooling towers can be performed
using CALPUFF in conjunction with a cooling tower emissions
processor (CTEMISS) and its associated postprocessors.  Hourly
emissions of water vapor and temperature from each cooling tower
cell are computed for the current cell configuration and ambient
conditions by CTEMISS. CALPUFF models the dispersion of these
emissions and provides cloud information in a specialized format
for further analysis. Output to FOG.DAT is provided in either
'plume mode' or 'receptor mode' format.
Configure for FOG Model output?
                        Default: 0    ! MFOG = 0 !
(MFOG)
  0 = no
  1 = yes  - report results in PLUME Mode format
  2 = yes  - report results in RECEPTOR Mode format

Test options specified to see if
they conform to regulatory
values? (MREG)              Default: 1    ! MREG = 0 !
  0 = NO checks are made
  1 = Technical options must conform to USEPA
     Long Range Transport (LRT) guidance
          METFM   1 or 2
          AVET    60. (min)
          PGTIME  60. (min)
          MGAUSS  1
          MCTADJ  3
          MTRANS  1
          MTIP    1
          MRISE   1
          MCHEM   1 or 3 (if modeling SOx, NOx)
          MWET    1
          MDRY    1
          MDISP   2 or 3
          MPDF    0 if MDISP=3
                  1 if MDISP=2
          MROUGH  0
          MPARTL  1
          MPARTLBA 0
          SYTDEP  550. (m)
          MHFTSZ  0
          SVMIN   0.5 (m/s)

!END!

-------------------------------------------------------------------------------
INPUT GROUP: 3a, 3b -- Species list
-------------------------

----------
Subgroup (3a)
------------
 The following species are modeled:
! CSPEC =       ODOR !          !END!

                                  Dry          OUTPUT GROUP
  SPECIES       MODELED       EMITTED     DEPOSITED          NUMBER
   NAME      (0=NO, 1=YES)  (0=NO, 1=YES)  (0=NO,          (0=NONE,
  (Limit: 12                    1=COMPUTED-GAS     1=1st CGRUP,
   Characters                     2=COMPUTED-PARTICLE  2=2nd CGRUP,
   in length)                     3=USER-SPECIFIED)    3= etc.)
!      ODOR =        1,            1,        1,           0  !

!END!
```

Note: The last species in (3a) must be 'BCON' when using the
boundary condition option (MBCON > 0). Species BCON should
typically be modeled as inert (no chem transformation or
removal).

Subgroup (3b)

The following names are used for Species-Groups in which results
for certain species are combined (added) prior to output. The
CGRUP name will be used as the species name in output files.
Use this feature to model specific particle-size distributions
by treating each size-range as a separate species.
Order must be consistent with 3(a) above.

INPUT GROUP: 4 -- Map Projection and Grid control parameters

Projection for all (X,Y):

Map projection
(PMAP) Default: UTM ! PMAP = UTM !
UTM : Universal Transverse Mercator
TTM : Tangential Transverse Mercator
LCC : Lambert Conformal Conic
PS : Polar Stereographic
EM : Equatorial Mercator
LAZA : Lambert Azimuthal Equal Area
False Easting and Northing (km) at the projection origin
(Used only if PMAP= TTM, LCC, or LAZA)
(FEAST) Default=0.0 ! FEAST = 0.0 !
(FNORTH) Default=0.0 ! FNORTH = 0.0 !
UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN) No Default ! IUTMZN = 56 !
Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM) Default: N ! UTMHEM = S !
N : Northern hemisphere projection
S : Southern hemisphere projection
Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0) No Default ! RLAT0 = 0.00N !
(RLON0) No Default ! RLON0 = 0.00E !
TTM : RLON0 identifies central (true N/S) meridian of projection
RLAT0 selected for convenience
LCC : RLON0 identifies central (true N/S) meridian of projection
RLAT0 selected for convenience
PS : RLON0 identifies central (grid N/S) meridian of projection
RLAT0 selected for convenience
EM : RLON0 identifies central meridian of projection
RLAT0 is REPLACED by 0.0N (Equator)
LAZA: RLON0 identifies longitude of tangent-point of mapping plane
RLAT0 identifies latitude of tangent-point of mapping plane
Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1) No Default ! XLAT1 = 30S !
(XLAT2) No Default ! XLAT2 = 60S !
LCC : Projection cone slices through Earth's surface at XLAT1 and XLAT2
PS : Projection plane slices through Earth at XLAT1
(XLAT2 is not used)

Note: Latitudes and longitudes should be positive, and include a
letter N,S,E, or W indicating north or south latitude, and
east or west longitude. For example,
35.9 N Latitude = 35.9N
118.7 E Longitude = 118.7E

Datum-region

The Datum-Region for the coordinates is identified by a character
string. Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-84). Other local
models may be in use, and their selection in CALMET will make its output
consistent with local mapping products. The list of Datum-Regions with
official transformation parameters is provided by the National Imagery and
Mapping Agency (NIMA).
NIMA Datum - Regions(Examples)

WGS-84 WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
NAS-C NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84 NWS 6370KM Radius, Sphere
ESR-S ESRI REFERENCE 6371KM Radius, Sphere
Datum-region for output coordinates
(DATUM) Default: WGS-84 ! DATUM = WGS-84 !

```
METEOROLOGICAL Grid (outermost if nested CALMET grids are used):
   Rectangular grid defined for projection PMAP,
   with X the Easting and Y the Northing coordinate
        No. X grid cells (NX)      No default    ! NX = 99 !
        No. Y grid cells (NY)      No default    ! NY = 99 !
      No. vertical layers (NZ)     No default    ! NZ = 12 !
        Grid spacing (DGRIDKM)     No default    ! DGRIDKM = 0.1 !
                        Units: km
           Cell face heights
             (ZFACE(nz+1))     No defaults
                        Units: m
 ! ZFACE =  0.0, 20.0, 60.0, 100.0, 150.0, 200.0, 250.0, 350.0, 500.0, 800.0, 1600.0, 2600.0, 4600.0 !
         Reference Coordinates
        of SOUTHWEST corner of
            grid cell(1, 1):
         X coordinate (XORIGKM)    No default    ! XORIGKM = 538.9000 !
         Y coordinate (YORIGKM)    No default    ! YORIGKM = 6805.3960 !
                        Units: km

COMPUTATIONAL Grid:
   The computational grid is identical to or a subset of the MET. grid.
   The lower left (LL) corner of the computational grid is at grid point
   (IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the
   computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
   The grid spacing of the computational grid is the same as the MET. grid.
     X index of LL corner (IBCOMP)      No default    ! IBCOMP = 1 !
           (1 <= IBCOMP <= NX)
     Y index of LL corner (JBCOMP)      No default    ! JBCOMP = 1 !
           (1 <= JBCOMP <= NY)

     X index of UR corner (IECOMP)      No default    ! IECOMP = 99 !
           (1 <= IECOMP <= NX)
     Y index of UR corner (JECOMP)      No default    ! JECOMP = 99 !
           (1 <= JECOMP <= NY)

SAMPLING Grid (GRIDDED RECEPTORS):
   The lower left (LL) corner of the sampling grid is at grid point
   (IBSAMP, JBSAMP) of the MET. grid. The upper right (UR) corner of the
   sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
   The sampling grid must be identical to or a subset of the computational
   grid. It may be a nested grid inside the computational grid.
   The grid spacing of the sampling grid is DGRIDKM/MESHDN.
     Logical flag indicating if gridded
     receptors are used (LSAMP)        Default: T    ! LSAMP = T !
     (T=yes, F=no)
     X index of LL corner (IBSAMP)      No default    ! IBSAMP = 1 !
      (IBCOMP <= IBSAMP <= IECOMP)
     Y index of LL corner (JBSAMP)      No default    ! JBSAMP = 1 !
      (JBCOMP <= JBSAMP <= JECOMP)

     X index of UR corner (IESAMP)      No default    ! IESAMP = 99 !
      (IBCOMP <= IESAMP <= IECOMP)
     Y index of UR corner (JESAMP)      No default    ! JESAMP = 99 !
      (JBCOMP <= JESAMP <= JECOMP)

     Nesting factor of the sampling
      grid (MESHDN)              Default: 1    ! MESHDN = 1 !
      (MESHDN is an integer >= 1)
!END!

-------------------------------------------------------------------------------

 INPUT GROUP: 5 -- Output Options
 ---------------
                                  *                *
    FILE                 DEFAULT VALUE          VALUE THIS RUN
    ----                 -------------          --------------
   Concentrations (ICON)          1              ! ICON = 1 !
   Dry Fluxes (IDRY)              1              ! IDRY = 0 !
   Wet Fluxes (IWET)              1              ! IWET = 0 !
   2D Temperature (IT2D)          0              ! IT2D = 0 !
   2D Density (IRHO)              0              ! IRHO = 0 !
   Relative Humidity (IVIS)       1              ! IVIS = 0 !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                  Default: T       ! LCOMPRS = T !
   *
    0 = Do not create file, 1 = create file

    QA PLOT FILE OUTPUT OPTION:
      Create a standard series of output files (e.g.
      locations of sources, receptors, grids ...)
      suitable for plotting?
      (IQAPLOT)                Default: 1       ! IQAPLOT = 1 !
```

```
    0 = no
    1 = yes
  DIAGNOSTIC PUFF-TRACKING OUTPUT OPTION:
    Puff locations and properties reported to
    PFTRAK.DAT file for postprocessing?
    (IPFTRAK)                Default: 0      ! IPFTRAK = 0 !
    0 = no
    1 = yes, update puff output at end of each timestep
    2 = yes, update puff output at end of each sampling step

  DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:
    Mass flux across specified boundaries
    for selected species reported?
    (IMFLX)                  Default: 0      ! IMFLX = 0 !
    0 = no
    1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
          are specified in Input Group 0)
    Mass balance for each species
    reported?
    (IMBAL)                  Default: 0      ! IMBAL = 0 !
    0 = no
    1 = yes (MASSBAL.DAT filename is
        specified in Input Group 0)

  NUMERICAL RISE OUTPUT OPTION:
    Create a file with plume properties for each rise
    increment, for each model timestep?
    This applies to sources modeled with numerical rise
    and is limited to ONE source in the run.
    (INRISE)                 Default: 0      ! INRISE = 0 !
    0 = no
    1 = yes (RISE.DAT filename is
          specified in Input Group 0)

  LINE PRINTER OUTPUT OPTIONS:
    Print concentrations (ICPRT)  Default: 0      ! ICPRT = 0 !
    Print dry fluxes (IDPRT)      Default: 0      ! IDPRT = 0 !
    Print wet fluxes (IWPRT)      Default: 0      ! IWPRT = 0 !
    (0 = Do not print, 1 = Print)
    Concentration print interval
    (ICFRQ) in timesteps          Default: 1      ! ICFRQ = 1 !
    Dry flux print interval
    (IDFRQ) in timesteps          Default: 1      ! IDFRQ = 1 !
    Wet flux print interval
    (IWFRQ) in timesteps          Default: 1      ! IWFRQ = 1 !
    Units for Line Printer Output
    (IPRTU)                  Default: 1      ! IPRTU = 5 !
                for          for
            Concentration  Deposition
       1 =     g/m**3       g/m**2/s
       2 =    mg/m**3      mg/m**2/s
       3 =    ug/m**3      ug/m**2/s
       4 =    ng/m**3      ng/m**2/s
       5 =  Odour Units
       6 =    TBq/m**3     TBq/m**2/s   TBq=terabecquerel
       7 =    GBq/m**3     GBq/m**2/s   GBq=gigabecquerel
       8 =    Bq/m**3      Bq/m**2/s    Bq=becquerel (disintegrations/s)
    Messages tracking progress of run
    written to the screen ?
    (IMESG)                  Default: 2      ! IMESG = 2 !
     0 = no
     1 = yes (advection step, puff ID)
     2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)

   SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS
           ---- CONCENTRATIONS ----  ------ DRY FLUXES ------  ------ WET FLUXES ------  -- MASS FLUX --
  SPECIES
  /GROUP      PRINTED?  SAVED ON DISK?  PRINTED?  SAVED ON DISK?  PRINTED?  SAVED ON DISK?  SAVED ON DISK?
  ------  ------------  --------------  --------  --------------  --------  --------------  --------------
!      ODOR =    1,          1,          1,          0,          1,          0,          0  !

  Note:  Species BCON (for MBCON > 0) does not need to be saved on disk.

    OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)
    Logical for debug output
    (LDEBUG)                   Default: F    ! LDEBUG = F !
    First puff to track
    (IPFDEB)                   Default: 1    ! IPFDEB = 1 !
    Number of puffs to track
    (NPFDEB)                   Default: 1    ! NPFDEB = 1000 !
    Met. period to start output
    (NN1)                      Default: 1    ! NN1 = 1 !
    Met. period to end output
    (NN2)                      Default: 10   ! NN2 = 10 !
!END!
```

```
INPUT GROUP: 6a, 6b, & 6c – Subgrid scale complex terrain inputs
-----------------------

--------------
Subgroup (6a)
--------------
     Number of terrain features (NHILL)      Default: 0    ! NHILL = 0 !
     Number of special complex terrain
     receptors  (NCTREC)                Default: 0    ! NCTREC = 0 !
     Terrain and CTSG Receptor data for
     CTSG hills input in CTDM format ?
     (MHILL)                            No Default    ! MHILL = 2 !
     1 = Hill and Receptor data created
        by CTDM processors & read from
        HILL.DAT and HILLRCT.DAT files
     2 = Hill data created by OPTHILL &
        input below in Subgroup (6b);
        Receptor data in Subgroup (6c)
     Factor to convert horizontal dimensions  Default: 1.0  ! XHILL2M = 1.0 !
     to meters (MHILL=1)
     Factor to convert vertical dimensions    Default: 1.0  ! ZHILL2M = 1.0 !
     to meters (MHILL=1)
     X-origin of CTDM system relative to      No Default    ! XCTDMKM = 0.0 !
     CALPUFF coordinate system, in Kilometers (MHILL=1)
     Y-origin of CTDM system relative to      No Default    ! YCTDMKM = 0.0 !
     CALPUFF coordinate system, in Kilometers (MHILL=1)
! END !
--------------
Subgroup (6b)
--------------
                1 **
   HILL information

HILL       XC      YC     THETAH  ZGRID  RELIEF   EXPO 1   EXPO 2   SCALE 1   SCALE 2   AMAX1    AMAX2
 NO.      (km)    (km)    (deg.)  (m)    (m)      (m)      (m)      (m)       (m)       (m)
----      ----    ----    ------  -----  ------   ------   ------   -------   -------   -----    -----


--------------
Subgroup (6c)
--------------
   COMPLEX TERRAIN RECEPTOR INFORMATION
               XRCT       YRCT       ZRCT       XHH
               (km)       (km)       (m)
               ------     -----      ------     ----


-----------------
1
   Description of Complex Terrain Variables:
      XC, YC  = Coordinates of center of hill
      THETAH  = Orientation of major axis of hill (clockwise from
            North)
      ZGRID   = Height of the  0  of the grid above mean sea
            level
      RELIEF  = Height of the crest of the hill above the grid elevation
      EXPO 1  = Hill-shape exponent for the major axis
      EXPO 2  = Hill-shape exponent for the major axis
      SCALE 1 = Horizontal length scale along the major axis
      SCALE 2 = Horizontal length scale along the minor axis
      AMAX    = Maximum allowed axis length for the major axis
      BMAX    = Maximum allowed axis length for the major axis
      XRCT, YRCT = Coordinates of the complex terrain receptors
      ZRCT    = Height of the ground (MSL) at the complex terrain
            Receptor
      XHH     = Hill number associated with each complex terrain receptor
            (NOTE: MUST BE ENTERED AS A REAL NUMBER)
  **
   NOTE: DATA for each hill and CTSG receptor are treated as a separate
      input subgroup and therefore must end with an input group terminator.
-------------------------------------------------------------------------

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
-------------
    SPECIES    DIFFUSIVITY    ALPHA STAR    REACTIVITY   MESOPHYLL RESISTANCE    HENRY'S LAW COEFFICIENT
    NAME       (cm**2/s)                    (s/cm)         (dimensionless)
    -------    ----------     ----------    ----------   --------------------    ----------------------
* DRYGAS = *
!END!

-------------------------------------------------------------------------

INPUT GROUP: 8 -- Size parameters for dry deposition of particles
-------------
   For SINGLE SPECIES, the mean and standard deviation are used to
   compute a deposition velocity for NINT (see group 9) size-ranges,
   and these are then averaged to obtain a mean deposition velocity.
   For GROUPED SPECIES, the size distribution should be explicitly
   specified (by the 'species' in the group), and the standard deviation
```

```
   for each should be entered as 0.  The model will then use the
   deposition velocity for the stated mean diameter.
    SPECIES     GEOMETRIC MASS MEAN      GEOMETRIC STANDARD
     NAME           DIAMETER                DEVIATION
                  (microns)                (microns)
    ------    ----------------       ----------------
* DRYPART = *
!END!

------------------------------------------------------------------------

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
-------------
   Reference cuticle resistance (s/cm)
   (RCUTR)                  Default: 30   ! RCUTR = 30 !
   Reference ground resistance  (s/cm)
   (RGR)                    Default: 10   ! RGR = 10 !
   Reference pollutant reactivity
   (REACTR)                 Default: 8    ! REACTR = 8 !
   Number of particle-size intervals used to
   evaluate effective particle deposition velocity
   (NINT)                   Default: 9    ! NINT = 9 !
   Vegetation state in unirrigated areas
   (IVEG)                   Default: 1    ! IVEG = 1 !
     IVEG=1 for active and unstressed vegetation
     IVEG=2 for active and stressed vegetation
     IVEG=3 for inactive vegetation
!END!

------------------------------------------------------------------------

INPUT GROUP: 10 -- Wet Deposition Parameters
--------------

              Scavenging Coefficient -- Units: (sec)**(-1)
    Pollutant     Liquid Precip.      Frozen Precip.
    --------    --------------      --------------
* WETDEPOS = *
!END!

------------------------------------------------------------------------

INPUT GROUP: 11a, 11b -- Chemistry Parameters
--------------------
-------------
Subgroup (11a)

   Several parameters are needed for one or more of the chemical transformation
   mechanisms.  Those used for each mechanism are:
                                    S
                          M         B R O
                          A B R R R  C H 4 B    N
                       B  V C N N N M K - - C O  D
                       C M G K I I I H H I I K F V E
                     M K N N N T T T 2 2 S S P R C C
                     O O H H H E E E O O R R M A N A
   Mechanism (MCHEM)   Z 3 3 3 3 1 2 3 2 2 P P F C X Y
   ----------------  ------------------------------------
   0 None            . . . . . . . . . . . . . . . .
   1 MESOPUFF II       X X . . X X X X . . . . . . . .
   2 User Rates      . . . . . . . . . . . . . . . .
   3 RIVAD           X X . . X . . . . . . . . . . .
   4 SOA             X X . . . . . . . . . . X X X .
   5 Radioactive Decay . . . . . . . . . . . . . . . X
   6 RIVAD/ISORRPIA    X X X X X X . . X X X X . . . .
   7 RIVAD/ISORRPIA/SOA  X X X X X X . . X X X X X X . .

   Ozone data input option (MOZ)    Default: 1        ! MOZ = 1 !
   (Used only if MCHEM = 1,3,4,6 or 7)
     0 = use a monthly background ozone value
     1 = read hourly ozone concentrations from
         the OZONE.DAT data file
   Monthly ozone concentrations in ppb (BCKO3)
   (Used only if MCHEM = 1,3,4,6, or 7 and either
     MOZ = 0, or
     MOZ = 1 and all hourly O3 data missing)
                        Default: 12*80.
   ! BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00 !
   Ammonia data option (MNH3)      Default: 0        ! MNH3 = 0 !
   (Used only if MCHEM = 6 or 7)
     0 = use monthly background ammonia values (BCKNH3) - no vertical variation
     1 = read monthly background ammonia values for each layer from
         the NH3Z.DAT data file
   Ammonia vertical averaging option (MAVGNH3)
   (Used only if MCHEM = 6 or 7, and MNH3 = 1)
     0 = use NH3 at puff center height (no averaging is done)
     1 = average NH3 values over vertical extent of puff
```

```
                    Default: 1          ! MAVGNH3 = 1 !
  Monthly ammonia concentrations in ppb (BCKNH3)
  (Used only if MCHEM = 1 or 3, or
       if MCHEM = 6 or 7, and MNH3 = 0)
                    Default: 12*10.
  ! BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00 !
  Nighttime SO2 loss rate in %/hour (RNITE1)
  (Used only if MCHEM = 1, 6 or 7)
  This rate is used only at night for MCHEM=1
  and is added to the computed rate both day
  and night for MCHEM=6,7 (heterogeneous reactions)
                    Default: 0.2        ! RNITE1 = 0.2 !
  Nighttime NOx loss rate in %/hour (RNITE2)
  (Used only if MCHEM = 1)
                    Default: 2.0        ! RNITE2 = 2 !
  Nighttime HNO3 formation rate in %/hour (RNITE3)
  (Used only if MCHEM = 1)
                    Default: 2.0        ! RNITE3 = 2 !

  H2O2 data input option (MH2O2)   Default: 1          ! MH2O2 = 1 !
  (Used only if MCHEM = 6 or 7, and MAQCHEM = 1)
    0 = use a monthly background H2O2 value
    1 = read hourly H2O2 concentrations from
      the H2O2.DAT data file
  Monthly H2O2 concentrations in ppb (BCKH2O2)
  (Used only if MQACHEM = 1 and either
    MH2O2 = 0 or
    MH2O2 = 1 and all hourly H2O2 data missing)
                    Default: 12*1.
  ! BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
--- Data for ISORROPIA Option
  (used only if MCHEM = 6 or 7)
  Minimum relative humidity used in ISORROPIA computations (RH_ISRP)
                    Default: 50.        ! RH_ISRP = 50.0 !
                    Units: %
  Minimum SO4 used in ISORROPIA computations (SO4_ISRP)
                    Default: 0.4        ! SO4_ISRP = 0.4 !
                    Units: ug/m3
--- Data for SECONDARY ORGANIC AEROSOL (SOA) Options
  (used only if MCHEM = 4 or 7)
  The MCHEM = 4 SOA module uses monthly values of:
     Fine particulate concentration in ug/m^3 (BCKPMF)
     Organic fraction of fine particulate    (OFRAC)
     VOC / NOX ratio (after reaction)        (VCNX)
  The MCHEM = 7 SOA module uses monthly values of:
     Fine particulate concentration in ug/m^3 (BCKPMF)
     Organic fraction of fine particulate    (OFRAC)
  These characterize the air mass when computing
  the formation of SOA from VOC emissions.
  Typical values for several distinct air mass types are:
    Month   1   2   3   4   5   6   7   8   9  10  11  12
          Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
  Clean Continental
    BCKPMF  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.
    OFRAC .15 .15 .20 .20 .20 .20 .20 .20 .20 .20 .20 .15
    VCNX   50. 50. 50. 50. 50. 50. 50. 50. 50. 50. 50. 50.
  Clean Marine (surface)
    BCKPMF .5  .5  .5  .5  .5  .5  .5  .5  .5  .5  .5  .5
    OFRAC .25 .25 .30 .30 .30 .30 .30 .30 .30 .30 .30 .25
    VCNX   50. 50. 50. 50. 50. 50. 50. 50. 50. 50. 50. 50.
  Urban - low biogenic (controls present)
    BCKPMF 30. 30. 30. 30. 30. 30. 30. 30. 30. 30. 30. 30.
    OFRAC .20 .20 .25 .25 .25 .25 .25 .25 .20 .20 .20 .20
    VCNX    4.  4.  4.  4.  4.  4.  4.  4.  4.  4.  4.  4.
  Urban - high biogenic (controls present)
    BCKPMF 60. 60. 60. 60. 60. 60. 60. 60. 60. 60. 60. 60.
    OFRAC .25 .25 .30 .30 .30 .55 .55 .55 .35 .35 .35 .25
    VCNX   15. 15. 15. 15. 15. 15. 15. 15. 15. 15. 15. 15.
  Regional Plume
    BCKPMF 20. 20. 20. 20. 20. 20. 20. 20. 20. 20. 20. 20.
    OFRAC .20 .20 .25 .35 .25 .40 .40 .40 .30 .30 .30 .20
    VCNX   15. 15. 15. 15. 15. 15. 15. 15. 15. 15. 15. 15.
  Urban - no controls present
    BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
    OFRAC .30 .30 .35 .35 .35 .55 .55 .55 .35 .35 .35 .30
    VCNX    2.  2.  2.  2.  2.  2.  2.  2.  2.  2.  2.  2.
  Default: Clean Continental
  ! BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
  ! OFRAC = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !
  ! VCNX = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00 !
--- End Data for SECONDARY ORGANIC AEROSOL (SOA) Options

   Number of half-life decay specification blocks provided in Subgroup 11b
   (Used only if MCHEM = 5)
   (NDECAY)                    Default: 0    ! NDECAY = 0 !
!END!
```

Subgroup (11b)

Each species modeled may be assigned a decay half-life (sec), and the associated mass lost may be assigned to one or more other modeled species using a mass yield factor. This information is used only for MCHEM=5.
Provide NDECAY blocks assigning the half-life for a parent species and mass yield factors for each child species (if any) produced by the decay.
Set HALF_LIFE=0.0 for NO decay (infinite half-life).

SPECIES NAME	a Half-Life (sec)	b Mass Yield Factor
-------	---------	----------

* SPECHLLIST = *
---
a
Specify a half life that is greater than or equal to zero for 1 parent species in each block, and set the yield factor for this species to -1
b
Specify a yield factor that is greater than or equal to zero for 1 or more child species in each block, and set the half-life for each of these species to -1
NOTE: Assignments in each block are treated as a separate input subgroup and therefore must end with an input group terminator.
If NDECAY=0, no assignments and input group terminators should appear.

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters

Horizontal size of puff (m) beyond which time-dependent dispersion equations (Heffter) are used to determine sigma-y and sigma-z (SYTDEP) Default: 550. ! SYTDEP = 550 !
Switch for using Heffter equation for sigma z as above (0 = Not use Heffter; 1 = use Heffter (MHFTSZ) Default: 0 ! MHFTSZ = 0 !
Stability class used to determine plume growth rates for puffs above the boundary layer (JSUP) Default: 5 ! JSUP = 5 !
Vertical dispersion constant for stable conditions (k1 in Eqn. 2.7-3) (CONK1) Default: 0.01 ! CONK1 = 0.01 !
Vertical dispersion constant for neutral/ unstable conditions (k2 in Eqn. 2.7-4) (CONK2) Default: 0.1 ! CONK2 = 0.1 !
Factor for determining Transition-point from Schulman-Scire to Huber-Snyder Building Downwash scheme (SS used for Hs <Hb + TBD * HL) (TBD) Default: 0.5 ! TBD = 0.5 !
TBD <0 ==> always use Huber-Snyder
TBD = 1.5 ==> always use Schulman-Scire
TBD = 0.5 ==> ISC Transition-point
Range of land use categories for which urban dispersion is assumed (IURB1, IURB2) Default: 10 ! IURB1 = 10 !
19 ! IURB2 = 19 !
Site characterization parameters for single-point Met data files ---------
(needed for METFM = 2,3,4,5)
Land use category for modeling domain (ILANDUIN) Default: 20 ! ILANDUIN = 20 !
Roughness length (m) for modeling domain (Z0IN) Default: 0.25 ! Z0IN = .25 !
Leaf area index for modeling domain (XLAIIN) Default: 3.0 ! XLAIIN = 3.0 !
Elevation above sea level (m) (ELEVIN) Default: 0.0 ! ELEVIN = .0 !
Latitude (degrees) for met location (XLATIN) Default: -999. ! XLATIN = -999.0 !
Longitude (degrees) for met location (XLONIN) Default: -999. ! XLONIN = -999.0 !
Specialized information for interpreting single-point Met data files -----
Anemometer height (m) (Used only if METFM = 2,3) (ANEMHT) Default: 10. ! ANEMHT = 10.0 !
Form of lateral turbulance data in PROFILE.DAT file (Used only if METFM = 4,5 or MTURBVW = 1 or 3) (ISIGMAV) Default: 1 ! ISIGMAV = 1 !
0 = read sigma-theta
1 = read sigma-v
Choice of mixing heights (Used only if METFM = 4) (IMIXCTDM) Default: 0 ! IMIXCTDM = 0 !
0 = read PREDICTED mixing heights
1 = read OBSERVED mixing heights
Maximum length of a slug (met. grid units) (XMXLEN) Default: 1.0 ! XMXLEN = 1 !
Maximum travel distance of a puff/slug (in grid units) during one sampling step (XSAMLEN) Default: 1.0 ! XSAMLEN = 1 !
Maximum Number of slugs/puffs release from one source during one time step

```
(MXNEW)                          Default: 99    ! MXNEW = 99 !
Maximum Number of sampling steps for
one puff/slug during one time step
(MXSAM)                          Default: 99    ! MXSAM = 99 !
Number of iterations used when computing
the transport wind for a sampling step
that includes gradual rise (for CALMET
and PROFILE winds)
(NCOUNT)                         Default: 2     ! NCOUNT = 2 !
Minimum sigma y for a new puff/slug (m)
(SYMIN)                          Default: 1.0   ! SYMIN = 1 !
Minimum sigma z for a new puff/slug (m)
(SZMIN)                          Default: 1.0   ! SZMIN = 1 !
Maximum sigma z (m) allowed to avoid
numerical problem in calculating virtual
time or distance.  Cap should be large
enough to have no influence on normal events.
Enter a negative cap to disable.
(SZCAP_M)                        Default: 5.0e06 ! SZCAP_M = 5000000 !
Default minimum turbulence velocities sigma-v and sigma-w
for each stability class over land and over water (m/s)
(SVMIN(12) and SWMIN(12))
          ---------- LAND ----------      --------- WATER ---------
  Stab Class :  A   B   C   D   E   F       A   B   C   D   E   F
                --- --- --- --- --- ---     --- --- --- --- --- ---
Default SVMIN : .50, .50, .50, .50, .50, .50,     .37, .37, .37, .37, .37, .37
Default SWMIN : .20, .12, .08, .06, .03, .016,    .20, .12, .08, .06, .03, .016
    ! SVMIN = 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.37, 0.37, 0.37, 0.37, 0.37, 0.37 !
    ! SWMIN = 0.2, 0.12, 0.08, 0.06, 0.03, 0.016, 0.2, 0.12, 0.08, 0.06, 0.03, 0.016 !
Divergence criterion for dw/dz across puff
used to initiate adjustment for horizontal
convergence (1/s)
Partial adjustment starts at CDIV(1), and
full adjustment is reached at CDIV(2)
(CDIV(2))                        Default: 0.0,0.0  ! CDIV = 0, 0 !
Search radius (number of cells) for nearest
land and water cells used in the subgrid
TIBL module
(NLUTIBL)                        Default: 4     ! NLUTIBL = 4 !
Minimum wind speed (m/s) allowed for
non-calm conditions. Also used as minimum
speed returned when using power-law
extrapolation toward surface
(WSCALM)                         Default: 0.5   ! WSCALM = 0.5 !
Maximum mixing height (m)
(XMAXZI)                         Default: 3000.  ! XMAXZI = 3000 !
Minimum mixing height (m)
(XMINZI)                         Default: 50.   ! XMINZI = 50 !

Temperatures (K) used for defining upper bound of
categories for emissions scale-factors
11 upper bounds (K) are entered; the 12th class has no upper limit
(TKCAT(11))
        Default  : 265., 270., 275., 280., 285., 290., 295., 300., 305., 310., 315.  (315.+)
                <<   <<   <<   <<   <<   <Temperature Class :  1   2   3   4   5   6   7   8   9   10  11  (12)
                --- ---- ---- ---- ---- ---- ---- ---- ---- ---- --- ---
        ! TKCAT = 265., 270., 275., 280., 285., 290., 295., 300., 305., 310., 315. !
Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))                Default   : ISC RURAL values
                       ISC RURAL : .07, .07, .10, .15, .35, .55
                       ISC URBAN : .15, .15, .20, .25, .30, .30
                  Stability Class :  A    B    C    D    E    F
                                     --- --- --- --- --- ---
                    ! PLX0 = 0.07, 0.07, 0.1, 0.15, 0.35, 0.55 !
Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))                Default: 0.020, 0.035
                    ! PTG0 = 0.02, 0.035 !
Default plume path coefficients for
each stabillty class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))            Stability Class :  A    B    C    D    E    F
                  Default  PPC : .50,  .50,  .50,  .50,  .35,  .35
                                 --- --- --- --- --- ---
                    ! PPC = 0.5, 0.5, 0.5, 0.5, 0.35, 0.35 !
Slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                  Default: 10.      ! SL2PF = 10 !
Receptor-specific puff/slug properties (e.g., sigmas and height above
ground at the time when the trajectory is nearest the receptor) may be
extrapolated forward or backward in time along the current step using
the current dispersion, for receptors that lie upwind of the puff/slug
position at the start of a step, or downwind at the end of a step.
Specify the upwind/downwind extrapolation zone in sigma-y units.
Using FCLIP=1.0 clips the the upwind zone at one sigma-y at the start
```

```
of the step and the downwind zone at one sigma-y at the end of the step.
This is consistent with the sampling done in CALPUFF versions through
v6.42 prior to the introduction of the FCLIP option.
The default is No Extrapolation, FCLIP=0.0.
(FCLIP)                    Default: 0.0      ! FCLIP = 0 !

Puff-splitting control variables ----------
  VERTICAL SPLIT
  ------------
  Number of puffs that result every time a puff
  is split - nsplit=2 means that 1 puff splits
  into 2
  (NSPLIT)                 Default:  3       ! NSPLIT = 3 !
  Time(s) of a day when split puffs are eligible to
  be split once again; this is typically set once
  per day, around sunset before nocturnal shear develops.
  24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
  0=do not re-split   1=eligible for re-split
  (IRESPLIT(24))           Default:  Hour 17 = 1
  ! IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0 !
  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                Default: 100.     ! ZISPLIT = 100 !
  Split is allowed only if ratio of last hour's
  mixing ht to the maximum mixing ht experienced
  by the puff is less than a maximum value (this
  postpones a split until a nocturnal layer develops)
  (ROLDMAX)                Default: 0.25     ! ROLDMAX = 0.25 !

  HORIZONTAL SPLIT
  ----------
  Number of puffs that result every time a puff
  is split - nsplith=5 means that 1 puff splits
  into 5
  (NSPLITH)                Default:  5       ! NSPLITH = 5 !
  Minimum sigma-y (Grid Cells Units) of puff
  before it may be split
  (SYSPLITH)               Default:  1.0     ! SYSPLITH = 1 !
  Minimum puff elongation rate (SYSPLITH/hr) due to
  wind shear, before it may be split
  (SHSPLITH)               Default:  2.      ! SHSPLITH = 2 !
  Minimum concentration (g/m^3) of each
  species in puff before it may be split
  Enter array of NSPEC values; if a single value is
  entered, it will be used for ALL species
  (CNSPLITH)               Default:  1.0E-07  ! CNSPLITH = 0 !
Integration control variables ----------
  Fractional convergence criterion for numerical SLUG
  sampling integration
  (EPSSLUG)                Default:  1.0e-04  ! EPSSLUG = 0.0001 !
  Fractional convergence criterion for numerical AREA
  source integration
  (EPSAREA)                Default:  1.0e-06  ! EPSAREA = 1E-006 !
  Trajectory step-length (m) used for numerical rise
  integration
  (DSRISE)                 Default:  1.0      ! DSRISE = 1.0 !
Boundary Condition (BC) Puff control variables ----------
  Minimum height (m) to which BC puffs are mixed as they are emitted
  (MBCON=2 ONLY).  Actual height is reset to the current mixing height
  at the release point if greater than this minimum.
  (HTMINBC)                Default:  500.    ! HTMINBC = 500 !
  Search radius (km) about a receptor for sampling nearest BC puff.
  BC puffs are typically emitted with a spacing of one grid cell
  length, so the search radius should be greater than DGRIDKM.
  (RSAMPBC)                Default:  10.     ! RSAMPBC = 10 !

  Near-Surface depletion adjustment to concentration profile used when
  sampling BC puffs?
  (MDEPBC)                 Default:  1       ! MDEPBC = 1 !
    0 = Concentration is NOT adjusted for depletion
    1 = Adjust Concentration for depletion
!END!

--------------------------------------------------------------------------------

INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
-----------------------------

---------------
Subgroup (13a)
---------------
  Number of point sources with
  parameters provided below     (NPT1)  No default  ! NPT1 = 1 !
  Units used for point source
  emissions below               (IPTU)  Default: 1  ! IPTU = 5 !
    1 =    g/s
    2 =    kg/hr
    3 =    lb/hr
```

```
      4 =   tons/yr
      5 =   Odour Unit * m**3/s  (vol. flux of odour compound)
      6 =   Odour Unit * m**3/min
      7 =   metric tons/yr
      8 =   Bq/s  (Bq = becquerel = disintegrations/s)
      9 =   GBq/yr
   Number of source-species
   combinations with variable
   emissions scaling factors
   provided below in (13d)       (NSPT1) Default: 0  ! NSPT1 = 0 !
   Number of point sources with
   variable emission parameters
   provided in external file     (NPT2)  No default  ! NPT2 = 0 !
   (If NPT2 > 0, these point
   source emissions are read from
   the file: PTEMARB.DAT)
!END!
--------------
Subgroup (13b)
--------------
                              a
      POINT SOURCE: CONSTANT DATA
      ---------------------------
                                                          b       c
 Source     X       Y      Stack   Base    Stack   Exit  Exit   Bldg.  Emission
  No.    Coordinate Coordinate Height Elevation Diameter Vel.  Temp.  Dwash   Rates
          (km)     (km)      (m)     (m)      (m)  (m/s) (deg. K)
 ------  ---------- ---------- ------  ------  --------- -----  -----  -----  ---------
  1 ! SRCNAM = DRYSTACK !
  1 ! X =  544.295, 6809.886,   18.3, 128.55,     1.06,  14.9,  357.0,  1.0,      1 !
  1 ! ZPLTFM =     0.0 !
  1 ! FMFAC =      1.0 !  !END!

--------
  a
   Data for each source are treated as a separate input subgroup
   and therefore must end with an input group terminator.
   SRCNAM  is a 12-character name for a source
         (No default)
   X       is an array holding the source data listed by the column headings
         (No default)
   SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
         (Default: 0.,0.)
   FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
         the effect of rain-caps or other physical configurations that
         reduce momentum rise associated with the actual exit velocity.
         (Default: 1.0  -- full momentum used)
   ZPLTFM  is the platform height (m) for sources influenced by an isolated
         structure that has a significant open area between the surface
         and the bulk of the structure, such as an offshore oil platform.
         The Base Elevation is that of the surface (ground or ocean),
         and the Stack Height is the release height above the Base (not
         above the platform).  Building heights entered in Subgroup 13c
         must be those of the buildings on the platform, measured from
         the platform deck.  ZPLTFM is used only with MBDW=1 (ISC
         downwash method) for sources with building downwash.
         (Default: 0.0)
  b
   0. = No building downwash modeled
   1. = Downwash modeled for buildings resting on the surface
   2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)
   NOTE: must be entered as a REAL number (i.e., with decimal point)
  c
   An emission rate must be entered for every pollutant modeled.
   Enter emission rate of zero for secondary pollutants that are
   modeled, but not emitted.  Units are specified by IPTU
   (e.g. 1 for g/s).
--------------
Subgroup (13c)
--------------
      BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
      -------------------------------------------------------
Source                                        a
 No.     Effective building height, width, length and X/Y offset (in meters)
         every 10 degrees.  LENGTH, XBADJ, and YBADJ are only needed for
         MBDW=2 (PRIME downwash option)
------   ------------------------------------------------------------------
  1 ! SRCNAM = DRYSTACK !
  1 ! HEIGHT =  15.70,  11.10,  15.70,  15.70,  15.70,  15.70,
                15.70,  15.70,  15.70,  15.70,  15.70,  15.70,
                15.70,  15.70,  15.70,  15.70,  15.70,  15.70,
                15.70,  11.10,  15.70,  15.70,  15.70,  15.70,
                15.70,  15.70,  15.70,  15.70,  15.70,  15.70,
                15.70,  15.70,  15.70,  15.70,  15.70,  15.70 !
  1 ! WIDTH  =  12.06,  9.53,  15.21,  17.34,  18.94,  31.98,
                37.36,  41.61,  44.60,  46.23,  46.58,  46.21,
                44.46,  41.36,  37.00,  31.52,  10.73,  11.57,
```

```
            12.06,  9.53,  15.21,  17.34,  18.94,  31.98,
            37.36,  41.61,  44.60,  46.23,  46.58,  46.21,
            44.46,  41.36,  37.00,  31.52,  10.73,  11.57 !
  1 ! LENGTH =  17.98,  21.69,  14.86,  14.01,  13.51,  37.00,
            31.52,  26.14,  21.71,  16.62,  12.66,  15.21,
            18.49,  25.62,  31.98,  37.36,  20.19,  19.38,
            17.98,  21.69,  14.86,  14.01,  13.51,  37.00,
            31.52,  26.14,  21.71,  16.62,  12.66,  15.21,
            18.49,  25.62,  31.98,  37.36,  20.19,  19.38 !
  1 ! XBADJ =  3.31,  -1.06,  5.01,  4.48,  3.05,  -22.87,
           -20.25, -17.02, -13.27,  -9.12,  -6.31,  -9.78,
           -12.95, -15.72, -18.02, -19.77, -20.92, -21.43,
           -21.29, -20.63, -19.87, -18.50, -16.57, -14.13,
           -11.27,  -9.12,  -8.44,  -7.51,  -6.35,  -5.43,
            -5.54,  -9.90, -13.96, -17.60,  0.73,  2.05 !
  1 ! YBADJ =  -1.48,  1.55,  2.18,  4.28,  6.25,  2.03,
             1.09,  0.11,  -0.87,  -1.82,  -2.66,  -3.24,
            -3.73,  -4.11,  -4.37,  -4.49,  3.75,  2.65,
             1.48,  -1.55,  -2.18,  -4.28,  -6.25,  -2.03,
            -1.09,  -0.11,  0.87,  1.82,  2.66,  3.24,
             3.73,  4.11,  4.37,  4.49,  -3.75,  -2.65 !
!END!
```

---

a
Building height, width, length, and X/Y offset from the source are treated as a separate input subgroup for each source and therefore must end with an input group terminator. The X/Y offset is the position, relative to the stack, of the center of the upwind face of the projected building, with the x-axis pointing along the flow direction.

Subgroup (13d)

---

a

POINT SOURCE: EMISSION-RATE SCALING FACTORS

Use this subgroup to identify temporal variations in the emission rates given in 13b. Factors assigned multiply the rates in 13b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use PTEMARB.DAT and NPT2 > 0. Sets of emission-rate scale factors are defined in Input Group 19, and are referenced by the FACTORNAME. Provide NSPT1 lines that identify the emission-rate scale factor table for each source-species combination that uses the scaling option. Note that a scale-factor table can be used with more than one source-species combination so a FACTORNAME can be repeated.

Source-Species No.	Source Name b (SRCNAM)	Species Name c (CSPEC)	Scale-factor table Name d (FACTORNAME)
-----	----------	----------	----------

---

a
Assignment for each source-specie is treated as a separate input subgroup and therefore must end with an input group terminator.

b
Source name must match one of the SRCNAM names defined in Input Group 13b

c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3

d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters

Subgroup (14a)

Number of polygon area sources with parameters specified below (NAR1) No default ! NAR1 = 0 !

Units used for area source emissions below (IARU) Default: 1 ! IARU = 1 !

1 = g/m**2/s
2 = kg/m**2/hr
3 = lb/m**2/hr
4 = tons/m**2/yr
5 = Odour Unit * m/s (vol. flux/m**2 of odour compound)
6 = Odour Unit * m/min
7 = metric tons/m**2/yr
8 = Bq/m**2/s (Bq = becquerel = disintegrations/s)
9 = GBq/m**2/yr

Number of source-species combinations with variable emissions scaling factors provided below in (14d) (NSAR1) Default: 0 ! NSAR1 = 0 !

Number of buoyant polygon area sources

```
   with variable location and emission
   parameters (NAR2)                  No default  ! NAR2 = 0 !
   (If NAR2 > 0, ALL parameter data for
   these sources are read from the file: BAEMARB.DAT)
!END!
--------------
Subgroup (14b)
--------------
                              a
       AREA SOURCE: CONSTANT DATA
       --------------------------
                                          b
Source        Effect.   Base     Initial   Emission
 No.          Height  Elevation  Sigma z     Rates
              (m)       (m)       (m)
-------       ------    -----    --------  ---------


--------
  a
   Data for each source are treated as a separate input subgroup
   and therefore must end with an input group terminator.
  b
   An emission rate must be entered for every pollutant modeled.
   Enter emission rate of zero for secondary pollutants that are
   modeled, but not emitted.  Units are specified by IARU
   (e.g. 1 for g/m**2/s).
--------------
Subgroup (14c)
--------------
        COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON
        ---------------------------------------------------
Source                                        a
 No.      Ordered list of X followed by list of Y, grouped by source
------    ----------------------------------------------------


--------
  a
   Data for each source are treated as a separate input subgroup
   and therefore must end with an input group terminator.

--------------
Subgroup (14d)
--------------
                                  a
       AREA SOURCE: EMISSION-RATE SCALING FACTORS
       ------------------------------------------
    Use this subgroup to identify temporal variations in the emission
    rates given in 14b.  Factors assigned multiply the rates in 14b.
    Skip sources here that have constant emissions.  For more elaborate
    variation in source parameters, use BAEMARB.DAT and NAR2 > 0.
    Sets of emission-rate scale factors are defined in Input Group 19, and
    are referenced by the FACTORNAME.  Provide NSAR1 lines that identify the
    emission-rate scale factor table for each source-species combination that
    uses the scaling option.  Note that a scale-factor table can be used with
    more than one source-species combination so a FACTORNAME can be repeated.

 Source-          Source     Species     Scale-factor table
 Species           Name  b    Name  c     Name      d
  No.           (SRCNAM)     (CSPEC)     (FACTORNAME)
 ------         ----------  ----------  ----------------


--------
  a
   Data for each species are treated as a separate input subgroup
   and therefore must end with an input group terminator.
  b
   Source name must match one of the SRCNAM names defined in Input Group 14b
  c
   Species name must match one of the CSPEC names of emitted species defined in Input Group 3
  d
   Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

-------------------------------------------------------------------
INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
--------------------------
--------------
Subgroup (15a)
--------------
   Number of buoyant line sources
   with variable location and emission
   parameters (NLN2)                  No default  ! NLN2 = 0 !
   (If NLN2 > 0, ALL parameter data for
    these sources are read from the file: LNEMARB.DAT)
   Number of buoyant line sources (NLINES)      No default   ! NLINES = 0 !
   Units used for line source
   emissions below             (ILNU)       Default: 1   ! ILNU = 1 !
       1 =      g/s
```

2 = kg/hr
3 = lb/hr
4 = tons/yr
5 = Odour Unit * m**3/s (vol. flux of odour compound)
6 = Odour Unit * m**3/min
7 = metric tons/yr
8 = Bq/s (Bq = becquerel = disintegrations/s)
9 = GBq/yr

Number of source-species combinations with variable emissions scaling factors provided below in (15c) (NSLN1) Default: 0 ! NSLN1 = 0 !

Maximum number of segments used to model each line (MXNSEG) Default: 7 ! MXNSEG = 7 !

The following variables are required only if NLINES > 0. They are used in the buoyant line source plume rise calculations.

Number of distances at which transitional rise is computed Default: 6 ! NLRISE = 6 !

Average building length (XL) (in meters) No default * XL = *

Average building height (HBL) (in meters) No default * HBL = *

Average building width (WBL) (in meters) No default * WBL = *

Average line source width (WML) (in meters) No default * WML = *

Average separation between buildings (DXL) (in meters) No default * DXL = *

Average buoyancy parameter (FPRIMEL) (in m**4/s**3) No default * FPRIMEL = *

!END!

Subgroup (15b)

BUOYANT LINE SOURCE: CONSTANT DATA

Source No.	Beg. X Coordinate (km)	Beg. Y Coordinate (km)	End. X Coordinate (km)	End. Y Coordinate (km)	Release Height[a] (m)	Base Elevation (m)	Emission Rates[b]
------	----------	----------	----------	----------	-------	----------	----------

---

a
Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

b
An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by ILNTU (e.g. 1 for g/s).

Subgroup (15c)

BUOYANT LINE SOURCE: EMISSION-RATE SCALING FACTORS[a]

Use this subgroup to identify temporal variations in the emission rates given in 15b. Factors assigned multiply the rates in 15b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use LNEMARB.DAT and NLN2 > 0. Sets of emission-rate scale factors are defined in Input Group 19, and are referenced by the FACTORNAME. Provide NSLN1 lines that identify the emission-rate scale factor table for each source-species combination that uses the scaling option. Note that a scale-factor table can be used with more than one source-species combination so a FACTORNAME can be repeated.

Source-Species No.	Source Name[b] (SRCNAM)	Species Name[c] (CSPEC)	Scale-factor table Name[d] (FACTORNAME)
------	----------	----------	----------

---

a
Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

b
Source name must match one of the SRCNAM names defined in Input Group 15b

c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3

d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters

Subgroup (16a)

Number of volume sources with
parameters provided in 16b,c (NVL1) No default ! NVL1 = 0 !
Units used for volume source
emissions below in 16b (IVLU) Default: 1 ! IVLU = 5 !
1 = g/s
2 = kg/hr
3 = lb/hr
4 = tons/yr
5 = Odour Unit * m**3/s (vol. flux of odour compound)
6 = Odour Unit * m**3/min
7 = metric tons/yr
8 = Bq/s (Bq = becquerel = disintegrations/s)
9 = GBq/yr
Number of source-species
combinations with variable
emissions scaling factors
provided below in (16c) (NSVL1) Default: 0 ! NSVL1 = 0 !
Number of volume sources with
variable location and emission
parameters (NVL2) No default ! NVL2 = 0 !
(If NVL2 > 0, ALL parameter data for
these sources are read from the VOLEMARB.DAT file(s))
!END!

Subgroup (16b)
---
a
VOLUME SOURCE: CONSTANT DATA
---
b
Source X Y Effect. Base Initial Initial Emission
No. Coordinate Coordinate Height Elevation Sigma y Sigma z Rates
(km) (km) (m) (m) (m) (m)
------ ---------- ---------- ------ ------ -------- -------- --------

---
a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.
b
An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by IVLU
(e.g. 1 for g/s).

Subgroup (16c)
---
a
VOLUME SOURCE: EMISSION-RATE SCALING FACTORS

Use this subgroup to identify temporal variations in the emission
rates given in 16b. Factors assigned multiply the rates in 16b.
Skip sources here that have constant emissions. For more elaborate
variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.
Sets of emission-rate scale factors are defined in Input Group 19, and
are referenced by the FACTORNAME. Provide NSVL1 lines that identify the
emission-rate scale factor table for each source-species combination that
uses the scaling option. Note that a scale-factor table can be used with
more than one source-species combination so a FACTORNAME can be repeated.

Source- Source Species Scale-factor table
Species Name b Name c Name d
No. (SRCNAM) (CSPEC) (FACTORNAME)
------ ---------- ---------- --------------------

---
a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.
b
Source name must match one of the SRCNAM names defined in Input Group 16b
c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3
d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

INPUT GROUP: 17 -- FLARE source control parameters (variable emissions file)

Number of flare sources defined in FLEMARB.DAT file(s)
(NFL2) Default: 0 ! NFL2 = 0 !
(At least 1 FLEMARB.DAT file is needed if NFL2 > 0)
!END!

INPUT GROUPS: 18a, 18b, 18c -- Road Emissions parameters

Subgroup (18a)

Emissions from roads are generated from individual line segments defined by a sequence of coordinates provided for each road-link. Each link is entered as a discrete source and is defined as a section of the road for which emissions are uniform.
A long, winding isolated road might be characterized by a single link made up of many coordinate triples (x,y,z) that describe its pathway. These points should be sufficient to resolve curves, but need not have uniform spacing. For example, a straight flat segment can be defined by 2 points, regardless of the distance covered. Long line segments are automatically divided further within the model into segments that are limited by the grid-cell boundaries (no segment may extend across multiple cells).
One emission rate (g/m/s) for each species is used for the entire road.
Near a congested intersection, many short links may be required to resolve the spatial and temporal distribution of emissions. Each is entered and modeled as a discrete source.
Number of road-links with emission parameters provided in Subgroup 18b (NRD1) No default ! NRD1 = 0 !
Number of road-links with arbitrarily time-varying emission parameters (NRD2) No default ! NRD2 = 0 !
(If NRD2 > 0, ALL variable road data are read from the file: RDEMARB.DAT)

Emissions from one or more of the roads presented in Subgroup 18b may vary over time-based cycles or by meteorology. This variability is modeled by applying an emission-rate scale factor specified for particular road links and species in Subgroup 18c.
Number of road links and species combinations with variable emission-rate scale-factors (NSFRDS) Default: 0 ! NSFRDS = 0 !

!END!

Subgroup (18b)

a
DATA FOR ROADS WITH CONSTANT OR SCALED EMISSION PARAMETERS

Road No.	Effect. Height (mAGL)	Initial Sigma z (m)	Initial Sigma y (m)	Emission Rates (g/s/m)
-------				

b

c

a
Data for each of the NRD1 roads are treated as a separate input subgroup and therefore must end with an input group terminator.

b
NSPEC Emission rates must be entered (one for every pollutant modeled). Enter emission rate of zero for secondary pollutants.

c
Road-source names are entered without spaces, and may be 16 characters long.

Subgroup (18c)

a
EMISSION-RATE SCALING FACTORS

Use this subgroup to identify temporal variations in the emission rates given in 18b. Factors assigned multiply the rates in 18b.
Skip sources here that have constant emissions. For more elaborate variation in source parameters, use RDEMARB.DAT and NRD2 > 0.
Sets of emission-rate scale factors are defined in Input Group 19, and are referenced by the FACTORNAME. Provide NSFRDS lines that identify the emission-rate scale factor table for each source-species combination that uses the scaling option. Note that a scale-factor table can be used with more than one source-species combination so a FACTORNAME can be repeated.

Source-Species No.	Source Name b (SRCNAM)	Species Name c (CSPEC)	Scale-factor table Name d (FACTORNAME)
------	----------	----------	----------

a
Assignment for each source-specie is treated as a separate input subgroup and therefore must end with an input group terminator.

b

```
   Source name must match one of the SRCNAM names defined in Input Group 18b
  c
   Species name must match one of the CSPEC names of emitted species defined in Input Group 3
  d
   Scale-factor name must match one of the FACTORNAME names defined in Input Group 19
--------------
Subgroup (18d)
--------------
                              a
        COORDINATES FOR EACH NAMED ROAD
        ------------------------------
              X         Y        Ground
Coordinate     Coordinate  Coordinate  Elevation
 No.           (km)      (km)        (m)
----------    ----------  ----------  ---------

--------
  a
   Each line of coordinates is treated as a separate input subgroup
   and therefore must end with an input group terminator.

-------------------------------------------------------------------------------

INPUT GROUPS: 19a, 19b -- Emission rate scale-factor tables
----------------------
   Use this group to enter variation factors applied to emission rates for any
   source-specie combinations that use this feature.  The tables of emission-rate
   scale factors are referenced by the name assigned to FACTORNAME.  These names
   do not need to include specific source or species names used in the simulation,
   particularly if one factor table is used for many types of sources and species,
   but should be descriptive.  But if a factor table applies to just one source,
   the reference name for it should generally contain that source-name.
   FACTORNAME must NOT include spaces.
   The FACTORTYPE for each table must be one of the following:
     CONSTANT1         1   scaling factor
     MONTH12           12  scaling factors: months 1-12
     DAY7              7   scaling factors: days 1-7
                       [SUNDAY,MONDAY, ... FRIDAY,SATURDAY]
     HOUR24            24  scaling factors: hours 1-24
     HOUR24_DAY7       168 scaling factors: hours 1-24,
                       repeated  7 times: SUNDAY, MONDAY, ... SATURDAY
     HOUR24_MONTH12    288 scaling factors: hours 1-24,
                       repeated 12 times: months 1-12
     WSP6              6   scaling factors: wind speed classes 1-6
                       [speed classes (WSCAT) defined in Group 12]
     WSP6_PGCLASS6     36  scaling factors: wind speed classes 1-6
                       repeated  6 times: PG classes A,B,C,D,E,F
                       [speed classes (WSCAT) defined in Group 12]
     TEMPERATURE12     12  scaling factors: temperature classes 1-12
                       [temperature classes (TKCAT) defined in Group 12]
   The number of tables defined may exceed the number of tables referenced in the
   input groups for each source type above (for convenience), but tables for all
   FACTORNAME names referenced must be present here.
--------------
Subgroup (19a)
--------------
   Number of Emission Scale-Factor
   tables                (NSFTAB) Default: 0  ! NSFTAB = 0 !
   !END!

--------------
Subgroup (19b)
--------------
                                        a,b,c
   Enter factors for NSFTAB Emission Scale-Factor tables



--------
  a
   Assignments for each table are treated as a separate input subgroup
   and therefore must end with an input group terminator.
  b
   FACTORNAME must be no longer than 40 characters
  c
   Spaces are NOT allowed in any FACTORNAME or FACTORTYPE assignment,
   and the names are NOT case-sensitive

-------------------------------------------------------------------------------
INPUT GROUPS: 20a, 20b, 20c -- Non-gridded (discrete) receptor information
----------------------
--------------
Subgroup (20a)
--------------
   Number of non-gridded receptors (NREC)  No default  ! NREC = 12 !
   Group names can be used to assign receptor locations in
   Subgroup 17c and thereby provide an identification that
```

can be referenced when postprocessing receptors. The
default assignment name X is used when NRGRP = 0.
Number of receptor group names (NRGRP) Default: 0 ! NRGRP = 0 !

!END!

Subgroup (20b)

Provide a name for each receptor group if NRGRP>0.
Enter NRGRP lines.

a,b

Group Name

---

* RGRPNAMLIST = *

---

a

Each group name provided is treated as a separate input subgroup
and therefore must end with an input group terminator.

b

Receptor group names must not include blanks.

Subgroup (20c)

---

a

NON-GRIDDED (DISCRETE) RECEPTOR DATA

	c	X	Y	Ground	Height	b	
Receptor No.	Group Name	Coordinate (km)	Coordinate (km)	Elevation (m)	Above Ground (m)		
1 ! X =		543.44304,	6810.20655,	131.1,	0.0 !	!END!	
2 ! X =		543.71255,	6810.30294,	137.3,	0.0 !	!END!	
3 ! X =		543.71059,	6810.19081,	140.6,	0.0 !	!END!	
4 ! X =		543.85616,	6810.12786,	145.0,	0.0 !	!END!	
5 ! X =		543.83649,	6809.94883,	147.0,	0.0 !	!END!	
6 ! X =		543.81092,	6809.80719,	150.4,	0.0 !	!END!	
7 ! X =		543.84829,	6809.69899,	149.9,	0.0 !	!END!	
8 ! X =		543.87190,	6809.51407,	147.1,	0.0 !	!END!	
9 ! X =		544.07847,	6809.40784,	141.8,	0.0 !	!END!	
10 ! X =		544.23585,	6809.45898,	137.0,	0.0 !	!END!	
11 ! X =		544.39520,	6809.40390,	137.3,	0.0 !	!END!	
12 ! X =		544.67061,	6809.40390,	138.6,	0.0 !	!END!	

---

a

Data for each receptor are treated as a separate input subgroup
and therefore must end with an input group terminator.

b

Receptor height above ground is optional. If no value is entered,
the receptor is placed on the ground.

c

Receptors can be assigned using group names provided in 17b. If no
group names are used (NRGRP=0) then the default assignment name X
must be used.

Attachment E EPA Complaints

61 Pine Avenue
East Ballina NSW 2478
T | 02 6686 51 83 M | 0448 483 837
tim@timfitzroy.com.au
ABN: 94120188829
ACN: 120188829
www.timfitzroy.com.au

NSW EPA

Our Reference: EF13/10070 DOC17/420588 -01
Contact: Peter Lynch (02) 6640 2502
Date: 1 September 2017

The General Manager
Ballina Shire Council
PO Box 450
Ballina NSW 2478

Attn: Kristy Bell

Dear Ms Bell,

Boral Asphalt Plant - Noise Impact Assessment and Bitumen Odour Management Plan.

I refer to Ballina Shire Council's letter of 10 August 2017 concerning Boral Asphalt Plant, 540 Gap Road, Alstonville. The letter seeks further the details regarding calls to *Environment Line* concerning the Boral Asphalt Plant. The letter also reiterated Council's previous request for the NSW Environment Protection Authority (EPA) to undertake independent monitoring of odour and noise emissions from the abovementioned premise.

In relation to the request for the details of the calls to *Environment Line*, please find attached to this letter the details of the calls to *Environment Line* concerning Bitupave - Boral Asphalt from January - June 2017.

In relation to the request for the EPA to undertake independent monitoring of odour and noise emissions, I refer Council to the EPA's letter of 5 September 2016 (attached) which advised: *the development of monitoring program is a key component of a BOMP and so will necessarily by carried out on behalf of the company as part of the development of the BOMP. The EPA does not normally carry out sampling and analysis of emissions as requested by Council.*

PO Box 498, Grafton NSW 2460
L2, 49 Victoria Street Grafton, NSW 2460
Tel: (02) 6640 2500 Fax: (02) 6640 2539
ABN 43 692 285 758
www.epa.nsw.gov.au

If you have any questions regarding the above, please contact Peter Lynch on (02) 6640 2502.

Yours sincerely

GRAEME BUDD
Head, Environmental Management Unit – North Coast
Environment Protection Authority

Cc: Johnson, Rod Rod.Johnson@boral.com.au

Details of the calls Environment Line concerning Bitupave Boral Asphalt Jan - June 2017

Incident Date/Time	Call Taken	Call Type	Boral Asphalt-Bitupave Alstonville Jan-June 2017 reports	Incident Location
24/05/2017 11:59:00 PM	24/05/2017 04:59.00 PM	300 NOISE/VIBRATION - 304 NON-LICENSED (EPA ARA) - Noise/vibration	Caller affected by night time noise from the Boral plant, machinery rumbling "Like a spaceship landing" - the noise is hard to describe. The caller notes that at this time of year the prevailing wind is generally from the direction of the plant. The caller typically stays up till around midnight, and the noise was present throughout the evening and as they were getting to sleep. Ongoing issue - the caller would appreciate quiet enjoyment of their home during the evening.	Boral/Bitupave, 498 Gap Road (de-listed premises)
15/05/2017 12:00:00 AM	23/05/2017 01:23:00 PM	300 NOISE/VIBRATION - 304 NON-LICENSED (EPA ARA) - Noise/vibration	The caller has been impacted by night-time noise from the asphalt plant, particularly on the evening of the 15th May up until about midnight when the caller finally got to sleep despite the noise. The noise comprised machinery noise, such as clunking and rumbling. On Wednesday the 17th the noise was also present until at least around midnight, but to a slightly lesser degree compared to the 15th May.	Boral/ Bitupave, 498 Gap Road (de-listed premises) Alstonville, noise impact to resident of Trinidad Court
15/05/2017 12:00.00 AM	18/05/2017 03:27:00 PM	300 NOISE/VIBRATION - 303 INDUSTRIAL - Odour Noise/vibration	Complaint of noise coming from Bitupave (old license #959), Gap Road Alstonville. The site is permitted to operate all night for 60 days a year but caller felt that noise levels were well over 5dba above background levels. Noise was a problem Monday 15th and Wednesday 17th May. Noise seemed to be louder before midnight. The noise was very intrusive. The caller noticed an odour last night for the first time.	Bitupave (old license #959), Gap Road Alstonville
17/05/2017 08.45 00 PM	18/05/2017 01:36.00 PM	200 AIR ODOURS - 203 INDUSTRIAL - Odour	Caller affected by strong bitumen odour from about 8:45pm last night, compelling the caller to close up the house . The caller also noted that the plant was audible as working when the caller was outdoors - this is unusual, they can't usually hear it. There was little wind at the time.	Boral/ Bitupave, 498 Gap Road (de-listed premises), odour impact to resident of Whipps Avenue Alstonville
17/05/2017 09:30:00 PM	18/05/2017 07:13:00 AM	200 AIR ODOURS - 203 INDUSTRIAL	After hours call Ref 144617 : Strong odour coming from Boral Asphalt Plant. Ongoing issues. Noticed last night 17/5/17 at 21:30 Strong fresh asphalt smell	Odour from Bitupave/ Boral Asphalt, Gap Road, Alstonville - EPL 959
17/05/2017 07:00:00 PM	18/05/2017 09:33:00 AM	300 NOISE/VIBRATION - 303 INDUSTRIAL - Odour Noise/vibration	Bitupave, Gap Road, Alstonville - EPL 959 Odour and noise affected caller at home last night at 41 Whipps Ave. Unpleasant petrochemical odour like oil or grease. Noticed between 7-10pm then caller went to bed. The odour was very strong even though he had sinus problems. Also noticeably loud noise, general plant operating noise. Odour strength = 5/6. Wind: light breeze, east or nor-east.	Bitupave, Gap Road, Alstonville - EPL 959. Odour and noise affected caller at home last night at 41 Whipps Ave.
16/01/2017 10:00:00 AM	16/01/2017 12.56.00 PM	200 AIR ODOURS - 203 INDUSTRIAL	Very strong tar/bitumen odours from Boral Asphalt, Gap Rd, Alstonville The odour was noticed today 16/1/17 from 10am and it is still present and its 13.00. Caller said the odour usually lasts for hours and it is very hot day today and rated the strength as 5 very strong. Caller cannot open the doors or windows nor can caller go outside to enjoy the gardening Caller has been living at her property for 6 years and said its always been an issue. Please contact caller.	Very strong tar/bitumen odours from Boral Asphalt, Gap Rd, Alstonville.

Attachment F EPA Licence Variations

61 Pine Avenue
East Ballina NSW 2478
T | 02 6686 51 83 M | 0448 483 837
tim@timfitzroy.com.au
ABN: 94120188829
ACN: 120188829
www.timfitzroy.com.au

Non-Compliance detail

Search Again Return to Licence Summary

Summary

Licence number: 3856
Annual Return Start: 16 Apr 2002
Annual Return End: 15 Apr 2003
Date Received: 19 May 2003

Licence Condition number	Type of non-compliance	EPA actions	No. of times occurred
M2	The condition requires sampling for each discharge event. As the dam is pumped out often this would amount to an enormous number of samples. Therefore Council has only done 11.	N/A	N/A
M2	The licence requires that the monitoring be carried out at the licensed discharge point. Council took samples from the pond and not the discharge point.	N/A	N/A
L4	The volume limit was exceeded on a number of occasions.	N/A	N/A

Non-Compliance detail

Search Again Return to Licence Summary

Summary

Licence number: 3856
Annual Return Start: 16 Apr 2003
Annual Return End: 15 Apr 2004
Date Received: 09 Jun 2004

Licence Condition number	Type of non-compliance	EPA actions	No. of times occurred
m2.1	A number of water samples were not taken during the period. It seems that a staff change resulted in the oversight.	N/A	N/A
L4.1	During three periods of wet weather the volume limit was exceeded for waters pumped to Branch Creek.	N/A	N/A

Non-Compliance detail

Search Again Return to Licence Summary

Summary

Licence number: 3856
Annual Return Start: 16 Apr 2005
Annual Return End: 15 Apr 2006
Date Received: 13 Jun 2006

Licence Condition number	Type of non-compliance	EPA actions	No. of times occurred
L3	Concentration limit of oil and grease exceeded the specified limit of 10mg/L.	EPA to monitor future compliance with this condition	3
L4	Volume limit exceeded 1500 kl/day.	EPA to monitor future compliance with this condition	9
M2	Sampling frequency - 2 samples required to be collected per calendar month. On 3 occasions only one sample result obtained due to laboratory errors.	EPA to monitor future compliance with this condition	3

Non-Compliance detail

Search Again Return to Licence Summary

Summary

Licence number: 3856
Annual Return Start: 16 Apr 2004
Annual Return End: 15 Apr 2005
Date Received: 15 Jun 2005

Licence Condition number	Type of non-compliance	EPA actions	No. of times occurred
M2.1	Council officers failed to take one set of samples during the period. There were 8 discharges during the year and only 7 were monitored.	Appropriate Action taken by licensee	1

Licence summary

Summary Licence No: 3856

View this licence (PDF document 130 kb)

Licence holder: BALLINA SHIRE COUNCIL
Premises: TUCKOMBIL QUARRY
486 GAP ROAD, ALSTONVILLE, NSW, 2477
LGA: BALLINA **Catchment:** Richmond
Administrative fee: $17,415.00
Licence status: Issued
Activity type: Land-based extractive activity
Licence review: Complete date 12 Apr 2016
Complete date 16 Mar 2014
Complete date 16 Mar 2009
Complete date 16 Mar 2004
Complete date 21 Jun 2001
Due date 12 Apr 2021
Pollution incident management plan: Last tested 03 May 2016
Current Environmental Risk Level: Level 1

Applications

Number	Application type	Current status	Date received
145096	s.55 Licence Transfer	Approved	03 Sep 2007
1533193	s.58 Licence Variation	Issued	10 Aug 2015
1546045	s.55 Licence Transfer	Approved	07 Sep 2016

Notices

For

Number	Issue date	Notice type
1004230	21 Jun 2001	s.58 Licence Variation
1027586	12 Jun 2003	s.58 Licence Variation
1035243	16 Mar 2004	s.58 Licence Variation
1036625	29 Apr 2004	s.58 Licence Variation
1510029	10 Dec 2012	s.58 Licence Variation
1518757	30 Jan 2014	s.58 Licence Variation
1533193	21 Aug 2015	s.58 Licence Variation

Annual Returns

Start date	End date	Date received	Non-compliance	LBL data
01-Nov-2016	15-Apr-2017	08-Jun-2017		Not available
16-Apr-2016	31-Oct-2016	07-Feb-2017	No	Not available
16-Apr-2015	15-Apr-2016	08-Jun-2016	No	Not available
16-Apr-2014	15-Apr-2015	12-Jun-2015	No	Not available
16-Apr-2013	15-Apr-2014	16-Jun-2014	No	Not available
16-Apr-2012	15-Apr-2013	27-Jun-2013	No	Not available
16-Apr-2011	15-Apr-2012	04-Jun-2012	No	Not available
16-Apr-2010	15-Apr-2011	16-Jun-2011	No	Not available
16-Apr-2009	15-Apr-2010	04-Jun-2010	No	Not available
16-Apr-2008	15-Apr-2009	05-Jun-2009	No	Not available
16-Apr-2007	15-Apr-2008	13-Jun-2008	No	Not available
16-Apr-2006	15-Apr-2007	14-Jun-2007	No	Not available
16-Apr-2005	15-Apr-2006	13-Jun-2006	yes	Not available
16-Apr-2004	15-Apr-2005	15-Jun-2005	yes	Not available
16-Apr-2003	15-Apr-2004	09-Jun-2004	yes	Not available
16-Apr-2002	15-Apr-2003	19-May-2003	yes	Not available
16-Apr-2001	15-Apr-2002	18-Jun-2002	No	Not available
16-Apr-2000	15-Apr-2001	15-Jun-2001	yes	Not available

Attachment G **Environmental Protection Licences**

61 Pine Avenue
East Ballina NSW 2478
T | 02 6686 51 83 M | 0448 483 837
tim@timfitzroy.com.au
ABN: 94120188829
ACN: 120188829
www.timfitzroy.com.au

Environment Protection Licence

Licence - 3856

Licence Details

Number: 3856
Anniversary Date: 16-April

Licensee

BALLINA SHIRE COUNCIL

PO BOX 450

BALLINA NSW 2478

Premises

TUCKOMBIL QUARRY
486 GAP ROAD
ALSTONVILLE NSW 2477

Scheduled Activity

Extractive activities

Fee Based Activity	Scale
Land-based extractive activity	> 100000-500000 T annual capacity to extract, process or store

Region

North - North Coast
NSW Govt Offices, 49 Victoria Street
GRAFTON NSW 2460
Phone: (02) 6640 2500
Fax: (02) 6642 7743

PO Box 498 GRAFTON
NSW 2460

Environment Protection Licence

Licence - 3856

Environment Protection Licence

Licence - 3856

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

The EPA publication "A Guide to Licensing" contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

BALLINA SHIRE COUNCIL

PO BOX 450

BALLINA NSW 2478

subject to the conditions which follow.

Environment Protection Licence

Licence - 3856

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Extractive activities	Land-based extractive activity	> 100000 - 500000 T annual capacity to extract, process or store

A1.2 Notwithstanding A1.1, the scale of the land-based extractive activity authorised under this licence must not exceed 150,000 tonnes per annum, being the amount equivalent to the extraction limit approved by the development consent granted under the *Environmental Planning and Assessment Act 1979* for the premises specified in A2.

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
TUCKOMBIL QUARRY
486 GAP ROAD
ALSTONVILLE
NSW 2477
LOT 2 DP 1130300

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

Environment Protection Licence

Licence - 3856

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Discharge to waters Discharge quality monitoring	Discharge to waters Discharge quality monitoring	Discharge from pump outlet pipe to Branch Creek shown as "Quarry water discharge point" on drawing titled Tuckombil Quarry - Alstonville received on 10 March 2004.

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

L2.4 Water and/or Land Concentration Limits

POINT 1

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	milligrams per litre				10
Total suspended solids	milligrams per litre				50

L3 Volume and mass limits

L3.1 For each discharge point or utilisation area specified below (by a point number), the volume/mass of:
a) liquids discharged to water; or;
b) solids or liquids applied to the area;
must not exceed the volume/mass limit specified for that discharge point or area.

Point	Unit of Measure	Volume/Mass Limit
1	kilolitres per day	1500

L4 Noise limits

L4.1 Noise from the licensed premise must not exceed an LAeq (15 minute) noise emission criterion of 38, except as expressly provided by this licence.

L4.2 Noise from the premises is to be measured at the most affected residential receiver to determine compliance with this condition.

L5 Blasting

L5.1 Blasting operations at the premises may only take place between 9:00 a.m. to 15:00 Monday to Friday. (Where compelling safety reasons exist, the Authority may permit a blast to occur outside the abovementioned hours. Prior written (or facsimile) notification of any such blast must be made to the Authority).

L5.2 The airblast overpressure level from blasting operations in or on the premises must not exceed:

a) 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period; and
b) 120 dB (Lin Peak) at any time.

At at any point within 1 metre of any affected dwelling unless the dwelling is subject to a private written agreeement

L5.3 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:

a) 5 mm/s for more than 5% of the total number of blasts carried out on the premises during each reporting period; and
b) 10 mm/s at any time.

At within 1 metres of any residential dwelling unless the dwelling is subject to a private written agreeement

L5.4 All sensitive recievers are to begiven at least 24 hours notice when blasting is to be undertaken.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and

c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Water and/ or Land Monitoring Requirements

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
Oil and Grease	milligrams per litre	Special Frequency 1	Representative sample
pH	pH	Special Frequency 1	Representative sample
Total suspended solids	milligrams per litre	Special Frequency 1	Representative sample

M2.3 For the purposes of the table(s) above Special Frequency 1 means the collection of samples less than one hour after the commencement of any discharge. In the event of frequent discharges, no more than two each month are required.

M3 Testing methods - concentration limits

M3.1 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:

a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 The preceding two conditions do not apply until 3 months after: the date of the issue of this licence.

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,
3. a Statement of Compliance - Licence Conditions,
4. a Statement of Compliance - Load based Fee,
5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
7. a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

R1.3 Where this licence is transferred from the licensee to a new licensee:
a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and

b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R2 Notification of environmental harm

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

Environment Protection Licence

Licence - 3856

Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales.*
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales.*
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence - 3856

flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

Environment Protection Licence

Licence - 3856

TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non-putrescible), special waste or hazardous waste

Mr Nigel Sargent

Environment Protection Authority

(By Delegation)

Date of this edition: 12-May-2000

Environment Protection Licence

Licence - 3856

End Notes

1 Licence varied by notice V/M upgrade, issued on 08-Jul-2000, which came into effect on 08-Jul-2000.

2 Licence varied by notice 1004230, issued on 21-Jun-2001, which came into effect on 16-Jul-2001.

3 Licence varied by notice 1027586, issued on 12-Jun-2003, which came into effect on 07-Jul-2003.

4 Licence varied by notice 1035243, issued on 16-Mar-2004, which came into effect on 10-Apr-2004.

5 Licence varied by notice 1036625, issued on 30-Apr-2004, which came into effect on 25-May-2004.

6 Licence transferred through application 145096, approved on 11-Sep-2007, which came into effect on 05-Sep-2007.

7 Condition A1.3 Not applicable varied by notice issued on <issue date> which came into effect on <effective date>

8 Licence varied by notice 1510029 issued on 10-Dec-2012

9 Licence varied by notice 1518757 issued on 30-Jan-2014

10 Licence varied by notice 1533193 issued on 21-Aug-2015

11 Licence transferred through application 1546045 approved on 27-Oct-2016 , which came into effect on 01-Nov-2016

Section 58(5) Protection of the Environment Operations Act 1997

Licence Variation

Department of **Environment & Climate Change** NSW

Licence - 959

BITUPAVE LTD,

Trading as BORAL ASPHALT,

ABN 53 000 102 376,

PO BOX 63,

TOONGABBIE NSW 2146

Attention: Mr. GREG JOHNSON

Notice Number 1087868

File Number LIC07/1058

Date 24-Jul-2008

NOTICE OF VARIATION OF LICENCE NO. 959

BACKGROUND

A. BITUPAVE LTD t/as BORAL ASPHALT ("the licensee") is the holder of Environment Protection Licence No. 959 ("the licence") issued under the *Protection of the Environment Operations Act 1997* ("the Act"). The licence authorises the carrying out of Scheduled Activity - Premises Based at GAP ROAD, ALSTONVILLE, NSW.

B. The purpose of this notice is to amend the license to include provisions for 24 hour operations and to remove completed Pollution Reduction Programs (PRPs).

VARIATION OF LICENCE NO. 959

1. By this notice the EPA varies licence No. 959 as set out in the Appendix. The Appendix contains a copy of the provisions of the licence marked with the variations that are made to it by this notice.
2. The variations to the licence are indicated in the following way:
   - if a strike through mark appears through any word or other text (eg. ~~Solids or~~) this indicates that the word or other text is deleted from the licence by this notice; and
   - if a double underline appears under any word or other text (eg. must be treated) this indicates that the word or other text is added to the licence by this notice.

Licence Variation

Department of **Environment & Climate Change** NSW

Licence - 959

. . . . . .

Mr Alex Purvis

Manager

North East - North Coast

(by Delegation)

INFORMATION ABOUT THIS NOTICE

- This notice is issued under 58(5) of the Act.
- Details provided in this notice, along with an updated version of the licence, will be available on the EPA's Public Register (http://www.environment.nsw.gov.au/prpoeo/index.htm) in accordance with section 308 of the Act.

Appeals against this decision

- You can appeal to the Land and Environment Court against this decision. The deadline for lodging the appeal is 21 days after you were given notice of this decision.

When this notice begins to operate

- The variations to the licence specified in this notice begin to operate immediately from the date of this notice, unless another date is specified in this notice.
- If an appeal is made against this decision to vary the licence and the Land and Environment Court directs that the decision is stayed the decision does not operate until the stay ceases to have effect or the Land and Environment Court confirms the decision or the appeal is withdrawn (whichever occurs first).

Section 55 Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence - 959

Department of **Environment & Climate Change** NSW

Licence Details

Number:	959
Anniversary Date:	01-September
Review Due Date:	27-Jun-2010

Licensee

BITUPAVE LTD
PO BOX 63
TOONGABBIE NSW 2146

Licence Type

Premises

Premises

BITUPAVE LTD
GAP ROAD
ALSTONVILLE NSW 2477

Scheduled Activity

Bitumen Pre-mix or Hot-mix Industries mixing

Fee Based Activity	Scale
Bitumen Pre-Mix or Hot-Mix Production (3) mixing	> 30000 - 100000 T produced

Region

North East - North Coast
NSW Govt Offices, 49 Victoria Street
GRAFTON NSW 2460
Phone: 02 6640 2500
Fax: 02 6642 7743

PO Box 498 GRAFTON
NSW 2460

Environment Protection Licence

Licence - 959

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act); and
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

The EPA publication "A Guide to Licensing" contains information about how to calculate your licence fees.

The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

BITUPAVE LTD
PO BOX 63
TOONGABBIE NSW 2146

subject to the conditions which follow.

1 Administrative conditions

A1 What the licence authorises and regulates

A1.1 Not applicable.

A1.2 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity
Bitumen Pre-mix or Hot-mix Industries mixing

Fee Based Activity	Scale
Bitumen Pre-Mix or Hot-Mix Production (& mixing	> 30000 - 100000 T produced

A1.3 Not applicable.

A2 Premises to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details

BITUPAVE LTD
GAP ROAD
ALSTONVILLE
NSW
2477
LOT 1 DP880416

A3 Other activities

A3.1 Not applicable.

A4 Information supplied to the EPA

A4.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
(a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
(b)the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

2 Discharges to air and water and applications to land

P1 Location of monitoring/discharge points and areas

P1.1 Not applicable.

P1.2 Not applicable.

P1.3 Not applicable.

3 Limit conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Load limits

L2.1 Not applicable.

L2.2 Not applicable.

L3 Concentration limits

L3.1 Not applicable.

L3.2 Not applicable.

L3.3 Not applicable.

L4 Volume and mass limits

L4.1 Not applicable.

L5 Waste

L5.1 Not applicable.

L6 Noise Limits

L6.1 Not applicable.

Environment Protection Licence

Licence - 959

L6.1 Noise from the premises must not exceed the limits as set out in Table 1.

Table 1

Location	Evening (dB(A))	Night (dB(A))
214 Teven Road*	N/A negotiated agreement in place	
29 Granada Parade	38 dB(A)	35 dB(A)
31 Teven Road	38 dB(A)	35 dB(A)

* Note: Negotiated agreement in place between the owner and occupier of 214 Teven Road and the licensee.

For the purpose of condition L6.1

(a) Evening is defined as the period from 6pm to 10pm.

(b) Night is defined as the period from 10pm to 7am Monday to Saturday, and 10pm to 8am Sundays and Public Holidays.

L6.2 Where the noise emission limits identified in this license have been exceeded the source should be established and repairs undertaken.

L6.3 To determine compliance with condition L6.1 noise must be measured at, or computed for the affected residences detailed in Table 1. Noise from the premises is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the affected dwelling (rural situations) where the dwelling is more than 30 metres from the boundary.

Where it can be demonstrated that direct measurement of noise from the premises is impractical, the licensee may use alternative means of demonstrating compliance to the EPA. (see Chapter 11 of the NSW Industrial Noise Policy).

A modifying factor correction must be applied for tonal, impulsive or intermittent noise in accordance with the "Environmental Noise Management - NSW Industrial Noise Policy" (January 2000)."

L6.4 The noise emission limits identified in condition L6.1 apply under calm meteorological conditions.

L7 Hours of Operation

L7.1 All work at the premises must normally be conducted between the hours 6:00am to 6:00pm Monday to Saturday inclusive.

L7.2 24 hour operations for up to 60 days per annum may be carried out at the premises. 24 hour operations are not to be conducted for more than 4 consecutive days at any time.

L7.3 Sunday work and work on public holidays is only to be undertaken where specific approval from the EPA has been received by the company for each event. Sunday or public holiday work must be justified by a case for urgent or emergency work.

L7.4 Records are to be kept for all operations conducted on Sundays, public holidays and for evening or night operations conducted between 6:00pm and 7:00am. These records are to include the times of start-up and shut down of the plant. All such records are to be available to the EPA on request.

4 Operating conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.

This includes:
(a)the processing, handling, movement and storage of materials and substances used to carry out the activity; and
(b)the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
(a) must be maintained in a proper and efficient condition; and
(b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

O4 Odour

O4.1 No condition of this licence identifies a potentially offensive odour for the purposes of section 129 of the Protection of the Environment Operations Act 1997.

Note: Section 129 of the Protection of the Environment Operations Act 1997, provides that the licensee must not cause or permit the emission of any offensive odour from the premises but provides a defence if the emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.

5 Monitoring and recording conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
(a) in a legible form, or in a form that can readily be reduced to a legible form;
(b) kept for at least 4 years after the monitoring or event to which they relate took place; and
(c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
(a) the date(s) on which the sample was taken;
(b) the time(s) at which the sample was collected;
(c) the point at which the sample was taken; and
(d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 Not applicable.

M3 Testing methods - concentration limits

M3.1 Not applicable.

M3.2 Not applicable.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:
(a) the date and time of the complaint;
(b) the method by which the complaint was made;
(c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
(d) the nature of the complaint;
(e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
(f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 Conditions M5.1 and M5.2 do not apply until 3 months after:
(a)the date of the issue of this licence or
(b)if this licence is a replacement licence within the meaning of the Protection of the Environment Operations (Savings and Transitional) Regulation 1998, the date on which a copy of the licence was served on the licensee under clause 10 of that regulation.

M6 Requirement to monitor volume or mass

M6.1 Not applicable.

6 Reporting conditions

R1 Annual return documents

What documents must an Annual Return contain?

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
(a) a Statement of Compliance; and
(b) a Monitoring and Complaints Summary.
A copy of the form in which the Annual Return must be supplied to the EPA accompanies this licence. Before the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

Period covered by Annual Return

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee:
(a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
(b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
(a) In relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
(b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

Deadline for Annual Return

R1.5 The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

Notification where actual load can not be calculated

R1.6 Not applicable.

Licensee must retain copy of Annual Return

R1.7 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

Certifying of Statement of Compliance and signing of Monitoring and Complaints Summary

R1.8 Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
(a) the licence holder; or
(b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R1.9 A person who has been given written approval to certify a certificate of compliance under a licence issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review of this licence.

R2 Notification of environmental harm

Note: The licensee or its employees must notify the EPA of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.1 Notifications must be made by telephoning the EPA's Pollution Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
(a) where this licence applies to premises, an event has occurred at the premises; or
(b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
(a) the cause, time and duration of the event;
(b) the type, volume and concentration of every pollutant discharged as a result of the event;
(c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
(d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
(e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
(f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
(g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

General conditions

G1 Copy of licence kept at the premises

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

Pollution studies and reduction programs

U1 PRP 1

The licensee must submit a report to DECC containing a proposal to install a stack silencer on the asphalt plant

Due Date: 6th of October 2007

U2 PRP 2

The licensee must install and commission a stack silencer on the asphalt plant

Due Date: 5th of February 2008

U3 PRP 3

The licensee must submit a noise compliance report to DECC undertaken by a suitably qualified independent acoustic consultant. The purpose of the report is to assess compliance with the agreed Project Specific Noise Levels of 38 dB(A) in the evening and 36 dB(A) during night time. The assessment and report must comply with the NSW Industrial Noise Policy (INP).

Due Date: 5th of February 2008

Special conditions

E1.1 Not applicable.

Dictionary

General Dictionary

In this licence, unless the contrary is indicated, the terms below have the following meanings:

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales.*
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales.*
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.

fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 1998.
flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
industrial waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
inert waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 months. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
reprocessing of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997

solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales.*
treatment of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste code	Means the waste codes listed in Appendix 5 of the EPA document A Guide to Licensing Part B.
waste type	Means Group A, Group B, Group C, inert, solid, industrial or hazardous waste

Mr Tim Gilbert

Environment Protection Authority

(By Delegation)

Date of this edition - 31-Jul-2007

End Notes

1	Licence varied by notice 1015880, issued on 17-Jul-2002, which came into effect on 11-Aug-2002.
2	Licence fee period changed by notice 1061522 on 08-Jun-2006.
3	Licence varied by notice 1076490, issued on 31-Jul-2007, which came into effect on 31-Jul-2007.