Metford Laboratories
environmental solutions

Metford Laboratories
92 Hill St, Carrington NSW 2294
(PO Box 175, Carrington NSW 2294)
• Ph +61 2 4902 9200 •
Fax +61 2 4902 9299
administrator@rca.com.au
www.metfordlabs.com.au

Metford Laboratories ref: 7337-503

17th March 2010

Tropic Tomago Pty Ltd
25-27 Kennington Drive
TOMAGO NSW 2322

Attention: Mr Rory O'Hagan

ENVIRONMENTAL NOISE MONITORING REPORT COMPILED FOR

TROPIC TOMAGO

DETAILING

OPERATIONAL NOISE MONITORING

MARCH 2010

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 ASSESSMENT METHODOLOGY 1

2.1 Noise Impact Assessment Criteria 1
2.2 Attended Noise Monitoring 1
2.3 Attended Noise Monitoring Back Calculations 2

3.0 RESULTS 4

3.1 Attended Noise Monitoring Results 4
3.2 Attended Noise Monitoring Back Calculation Results 4
3.3 Noise Impact Assessment Criteria Results 5

4.0 DISCUSSION 5

5.0 LIMITATIONS 6

LIST OF TABLES

TABLE 1 Noise Impact Assessment Criteria 1

TABLE 2 Operation Stage Attended Noise Monitoring Details 2

TABLE 3 Noise Monitoring Locations & Distances to In-Pit Noise Source 3

TABLE 4 Operation Stage Attended Noise Monitoring Results 4

TABLE 5 Operation Stage Attended Noise Monitoring Back Calculated Results 4

TABLE 6 Noise Monitoring Back-Calculation Results & Noise Impact Assessment Criteria Comparison 5

1.0 INTRODUCTION

Metford Laboratories has been engaged to perform noise monitoring of the Tropic Tomago Pty Ltd premises, 25-27 Kennington Drive, Tomago. The purpose of noise monitoring was to determine compliance with noise limits under the Environmental Protection Licence (EPL) 12806.

Noise monitoring was undertaken on the evening of the 9th March 2010. Monitoring was undertaken at the four boundary corners of premises. As the distance to the nearest affected residence is shown to be approximately 420m to the East, calculations have been made to estimate the noise emitted by the Tropic Tomago plant at this nearest sensitive receiver.

2.0 ASSESSMENT METHODOLOGY

2.1 Noise Impact Assessment Criteria

As stipulated in EPL 12806, noise generated by the premises must not exceed the noise impact assessment criteria presented in **Table 1**.

TABLE 1 *Noise Impact Assessment Criteria*

Assessment Period	Assessment Criteria ($L_{Aeq,\ 15\ minute}$)
Day	50.5dB
Evening	51.0dB
All Other Times	45.0dB

For the purpose of the assessment criteria, the Day and Evening periods are defined as follows:

Day - 7am to 6pm Monday to Saturday, and 8am to 6pm Sundays and public holidays;

Evening - 6pm to 10pm Monday to Friday

L_{Aeq} means the equivalent continuous noise level – the level of noise equivalent to the energy-average of noise levels occurring over the measurement period.

2.2 Attended Noise Monitoring

A SVAN 945 Sound Level Meter was used to analyse the noise environment at the Tropic Tomago premises on the 9th March 2010. Attended noise monitoring consisted of one 15-minute noise measurement during the Evening period (6:00pm to 10:00pm) at each of the four monitoring sites. The L_{Aeq} noise level was measured using Fast response setting on the sound level meter. All

measurements were undertaken during periods of suitable climatic conditions, that is wind speeds of less than 3m/s, and the absence of temperature inversions.

The location of all monitoring sites is shown in Drawing 1, **Appendix 1** – Noise Monitoring Locations. The details of attended noise monitoring are shown in **Table 2**.

TABLE 2 *Operation Stage Attended Noise Monitoring Details*

Monitoring Site	**NM1**	**NM2**	**NM3**	**NM4**
Noise Meter Used	SVAN 945	SVAN 945	SVAN 945	SVAN 945
Measurement Started	9/03/10 19:27	9/03/10 19:44	9/03/10 20:01	9/03/10 21:09
Measurement Stopped	9/03/10 19:42	9/03/10 19:59	9/03/10 20:16	9/03/10 21:24
Pre-measurement Reference	93.8	93.8	93.8	93.8
Post-Measurement Reference	93.8	93.8	93.8	93.8
Frequency Weighting	A	A	A	A
Time Response	F	F	F	F
Engineering Units	dB SPL	dB SPL	dB SPL	dB SPL

2.3 Attended Noise Monitoring Back Calculations

Monitoring sites NM1, NM2, NM3 and NM4 are all located within the boundary of the Tropic Tomago premises. The nearest sensitive receiver to the site is approximately 420m to the east, adjacent to both the Pacific Highway and Tomago Road. In order to estimate the effect of noise emitted from the premises on the nearest affected residence without the interference of dominant road traffic noise, the noise data has been back calculated to enable a more reliable estimate of the noise contribution from the Tropic Tomago premises.

Chapter 11 Section 11.1.2 of the NSW Industrial Noise Policy states: "*When compliance is being measured it may be found that, in many cases, existing noise levels are higher than noise levels from the source, making it difficult to separate out the source noise level. When this happens, it may not be feasible to measure compliance at the specified location, and other methods will be needed. In these cases, measurements may be taken closer to the source and then calculated back to the specified location.*"

Calculations made are based on the sound propagation '6dB rule' which states that sound decays at a rate of 6dB per doubling of distance away from the noise source, in free space.
The 6dB rule of sound propagation is represented by the formula:

$$L_{p2} = L_{p1} - 20 \log (r_2/r_1) \text{ dB}$$

Where: L_{p1} is the sound pressure level at a distance r_1
L_{p2} is the sound pressure level at a distance r_2

Using GPS co-ordinates the distance from the noise sources associated with Tropic Tomago premises activities was determined for each noise monitoring location. These distances are shown in **Table 3** and were used in the sound propagation calculations.

TABLE 3 *Noise Monitoring Locations & Distances to In-Pit Noise Source*

Date	Monitoring Location	Distance from Noise Source to Measurement Position (m)	Distance from Noise Source to Residence
			R1
9/03/10	NM1	15	420
9/03/10	NM2	15	470
9/03/10	NM3	15	490
9/03/10	NM4	15	440

Results of attended noise monitoring and back calculations are shown in Section 3.

3.0 RESULTS

3.1 Attended Noise Monitoring Results

Results of attended noise monitoring are shown in **Table 5**. A complete raw data set is available upon request.

TABLE 4 *Operation Stage Attended Noise Monitoring Results*

Site	Date	Time Start	Time Stop	L_{Aeq} (15minute)	L_{A10}	L_{A50}	L_{A90}	L_{Min}	L_{Max}	Field Comments
NM1	9/03/10	19:27	19:42	71	73	63	61	60	88	Plant operating. Front End Loader collecting drum from behind shed. Truck in wash-down bay and driving past microphone.
NM2	9/03/10	19:44	19:59	73	75	72	70	69	83	Plant operating at distance of 15m. Truck reversing towards microphone and coupling onto trailer.
NM3	9/03/10	20:01	20:16	69	70	68	58	56	85	Plant operating until final six minutes of monitoring period. Front End Loader and trucks driving past microphone.
NM4	9/03/10	21:09	21:24	74	78	62	60	58	93	Plant operating. Trucks entering site, driving past microphone.

3.2 Attended Noise Monitoring Back Calculation Results

Results of noise monitoring back-calculated from the Tropic Tomago premises to the nearest affected residence is shown in **Table 6**.

TABLE 5 *Operation Stage Attended Noise Monitoring Back Calculated Results*

Date	Location	Distance from Noise Source to Measurement Position (m)	Distance from Noise Source to Residence	LAeq 15-minute (dB) at Monitoring Location	Calculated Attended LAeq 15-minute (dB) at Residence
			R1		R1
9/03/10	NM1	15	420	71	42
9/03/10	NM2	15	470	73	43
9/03/10	NM3	15	490	69	39
9/03/10	NM4	15	440	74	44

3.3 Noise Impact Assessment Criteria Results

Results of noise monitoring back-calculations for the nearest affected residence are shown in **Table 7** below, compared with the respective Noise Impact Assessment Criteria.

TABLE 6 *Noise Monitoring Back-Calculation Results & Noise Impact Assessment Criteria Comparison*

Date	Location	Actual Noise Level Recorded at site	Back Calculated LAeq 15-minute Result at Residence (dB)
			R1
9/03/10	NM1	71	42
9/03/10	NM2	73	43
9/03/10	NM3	69	39
9/03/10	NM4	74	44
Noise Impact Assessment Criteria (Evening)			**51**

Notes:
* Estimated noise level using back-calculation methodology.

4.0 DISCUSSION

Attended noise monitoring of the Tropic Tomago premises was undertaken at four monitoring sites on the 9th March 2010. Refer **Appendix 1** for noise monitoring locations.

Noise monitoring at the site close showed an $L_{Aeq\ (15\ minute)}$ level of between 69dB(A) and 74dB(A) at a distance of 15m from operating plant equipment. The result of 69dB(A) recorded at monitoring site NM3 is slightly lower than the other results recorded at the site. This may be attributed to the fact that during the last 6 minutes of the monitoring period the manufacturing plant was noted to be ceasing production and winding down. Monitoring resumed an hour later when the plant resumed operation.

Using the attended monitoring figures, data was back calculated to enable the noise levels at the nearest sensitive receiver (a residence on Tomago Road) to be estimated.

The monitoring of noise generated by the Tropic Tomago operations at the premises allows for noise data to be obtained for the nearest sensitive receiver without the interference of other local noise sources such as the nearby Pacific Highway and Tomago road; as well as other industry operations located within the Tomago area.

Noise data calculation results are shown to be lower than the Evening noise impact assessment criteria (51dBA) stipulated in the EPL 12806.

The back-calculation results are also shown to be lower than the noise impact assessment criteria for the Daytime period (50.1dBA) and all other times periods (45dBA). This indicates that noise from the Tropic Tomago premises is predicted to have a minimal impact on the ambient noise levels of the nearest sensitive receiver.

5.0 LIMITATIONS

This report has been prepared for Tropic Tomago Pty Ltd in accordance with quotation reference 7337-102 dated 5th March 2010. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the use of Tropic Tomago Pty Ltd. The report may not contain sufficient information for purposes of other uses or for parties other than Tropic Tomago Pty Ltd. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without written permission from RCA.

The information in this report is considered accurate at the date of issue. Please contact the undersigned if you have any queries on the above.

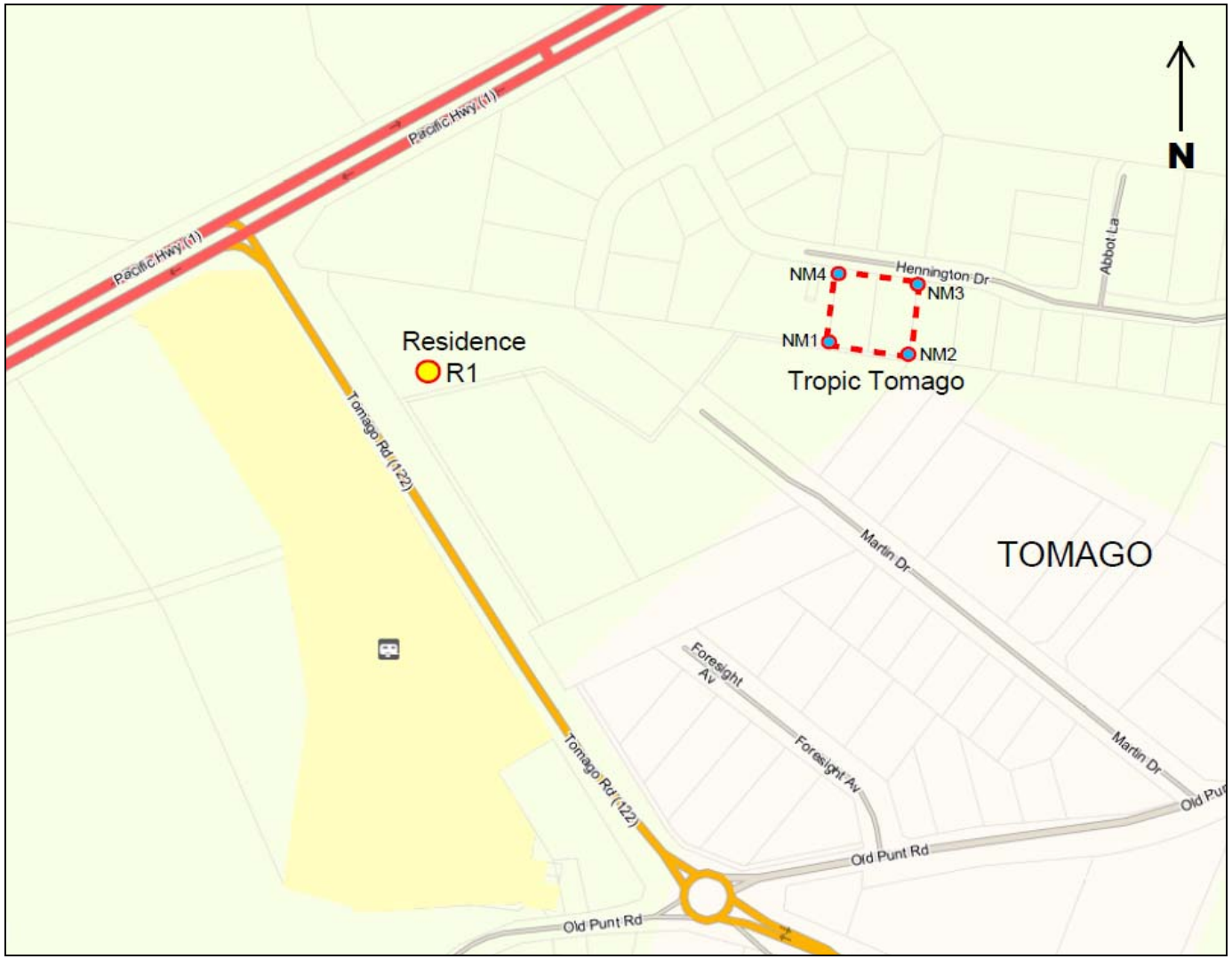
Yours sincerely

Karen Tripp
Senior Environmental Scientist
RCA Australia Pty Ltd trading as
Metford Laboratories

Geoff Mason
Environmenal Services Manager
RCA Australia Pty Ltd trading as
Metford Laboratories

Appendix 1

Noise Monitoring Locations



Drawing 1 – Tropic Tomago Noise Monitoring Locations – March 2010.

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Sound & Vibration
Occupational Hygiene

RCA ref 11067-701/0

12 November 2014

Tropic Asphalts
25-27 Kennington Drive
TOMAGO NSW 2322

Attention: Mr Nigel Little

ODOUR AND STACK VELOCITY MONITORING
TROPIC ASPHALTS TOMAGO PLANT, NOVEMBER 2014

Thank you for requesting RCA to carry out this additional work, which comprised the following:

- Odour testing for the purposes of assessing ambient levels at the plant boundary. This follows a recent odour complaint from a neighbour immediately adjacent to the Tropic Asphalts plant boundary. In addition, the main stack was tested for odour.
- Velocity testing of the main stack, for Tropic Ashpalts' internal purposes including the consideration of an increase to the stack velocity for improving the dispersion of air emissions.

The following sections summarise the methods used, the results, RCA's findings and recommendations.

1 ODOUR MONITORING AND RESULTS

Three (3) samples for odour were taken on Thursday 6 November 2014 from the following locations by RCA staff:

- Two (2) boundary ground level locations for ambient air. These were taken from the eastern boundary (refer to **Table 1** for further detail). The weather conditions on the day of sampling were favourable for odour measurements - mild to cool and no rain. The sampling locations were selected based on consideration of the boundary

downwind of the source of the odours (the main stack and the truck 'hopper' loading point). There was a prevailing wind at the time of collecting the ground level samples, with the direction varying between west-north-west to west. The plant was operating under full conditions without any delays to production.

- The main stack at the same location used by RCA for other air emissions testing. The plant was operating under full conditions without any delays to production.

Sampling from each location was undertaken in accordance with the industry recognised (and preferred) 'lung in drum' method. The method involves placing the sample bag in a sampling drum and a pump is used to create a vacuum in the drum to draw the sample air into the bag. In this way, cross-contamination of the samples and pumps and inaccurate odour results are eliminated.

At the completion of sampling, all odours were immediately labelled, sealed and transported to a NATA accredited laboratory for analysis (The Odour Unit, Sydney, NSW) within thirty-two (32) hours of conducting the sampling. Odour concentration measurements were performed using dynamic olfactometry according to the appropriate Australian Standard (Ref [1]).

Results of the odour monitoring carried out on 6 November 2014 are presented in **Table 1**. The full laboratory report is presented in **Appendix A**.

Table 1 *Odour Sampling Measurement Results – Tropic Asphalts Tomago Plant, Thursday 6 November 2014*

Odour Sample Number and Sampling Location	Sampling times (inclusive)	Sample Odour Concentration (OU), as Analysed by The Odour Unit (Refer to note 2)	Odour Concentration Guideline (Refer to note 1)
TROP-1 Plant Boundary – Eastern, 23m from south-east corner	7.30 – 7.38 a.m.	235	2.0 to 3.0
TROP-2 Plant Boundary – Eastern, 33m from north-east corner	7.51 – 7.58 a.m.	118	2.0 to 3.0
TROP-3 Main Stack	8.41 – 8.47 a.m.	790	Not applicable, see boundary location guideline above

Notes:

1. Approximate only to compare with the measured results. The exact guideline is based on a number of factors including the population in the vicinity of the site (Table 7.5 of Ref [2]).

2. The Lower Detection Level of the testing laboratory is 16 Odour units. It is very difficult to obtain odour test results less than 16 odour units given this limitation and other practical considerations. This Lower Detection Level is amongst the lowest achievable for testing laboratories in Australia.

2 VELOCITY MEASUREMENTS FROM THE MAIN STACK

In addition to odour, other measurements were carried out on the main stack:

- Stack gas dynamic pressures were measured by using a calibrated pitot tube and inclined manometer. Stack gas temperatures were measured using a calibrated thermometer which was integrated into the pitot tube. This allowed for pressure and temperature measurements at each 'traverse' location. Two access ports were used for these measurements.
- A static pressure measurement was taken from the centre of the stack.

At each 'traverse' location the velocity was calculated using a number of measurements (including differential pressure and static pressure readings from the pitot tube), temperature and barometric pressure and gas density (calculated from the pressures and temperatures). The volumetric flow rate at actual 'stack' conditions was calculated by using the velocity and cross-sectional area of the stack. These methods conform to Australian Standards.

A summary of the stack parameters is shown in **Table 2**.

Table 2 *Summary of Stack Parameters*

Average Velocity, m/s	Velocity Range, m/s (Refer to note 1)	Average Temperature (T), ^{0}C	Volumetric Flow Rate, m^3/h (actual conditions)	Volumetric Flow Rate, m^3/h (standard conditions of 0 ^{0}C, 1 atm. Pressure)	Static Pressure (Pascals)
9.7	5.4 to 16.1	114	55,275	39,075	39

Notes:

Across 14 traverse positions (two sampling ports, seven positions per port). It should be noted that the sampling location is not ideal, as the access ports are located too close to a bend in the ductwork. This is demonstrated by the *range* of velocities shown in **Table 2**. Ideally, the sampling location should be positioned at least six stack diameters (approximately 8.5 metres) downstream of any bend or another flow disturbance. This will provide enough distance for the gas flow to be more evenly distributed. To overcome this problem, RCA took more traverse positions than the required minimum (12), therefore the *average* velocity is more reliable.

3 DISCUSSION OF TEST RESULTS AND RECOMMENDATIONS

The odour results obtained at the plant boundary locations are considered by RCA to be noticeable, but not offensive. At the time of collecting the samples, RCA personnel detected odours from the plant and these were observed as rubber and asphalt in odour character. It should be noted that the odour results were representative of more than one odour source at the site, ie, not just the main stack. Odour sampling at the plant boundary locations was also taken directly downwind of the 'hopper' area when trucks were being loaded with product. Under adverse weather conditions such as a cold, still morning and when a thermal inversion occurs, these odour levels may be detected at neighbouring premises and a complaint could occur. However, the truck loading operation is only short in duration and the odour from this operation may only be detected for short periods.

The average gas velocity measured in the main stack was 9.7 m/s. Although this is greater than the velocity previously measured by RCA on 10/07/14 (5.4 m/s), it is below the industry accepted and recommended 'minimum' velocity of 15 m/s. The measured velocity may not be providing sufficient dispersion of odours from the main stack and the odours may cause a complaint under certain weather conditions.

There are methods of achieving stack velocities of 15 m/s or greater. In summary, the most practical and cost effective methods are:

- In the first instance, the fan characteristics should be checked and compared to the manufacturer's specifications. RCA suspects that the fan may not be performing to its potential, as indicated by the static pressure measured in the main stack. This pressure could be too low (despite an expected loss of pressure across the bag house) and a possible reason for the low velocities. Following checks of the fan the ductwork and bag house should be checked for any build-up of materials and cleaned if necessary.

  If the fan is found to be performing to the manufacturer's specifications but is at an unsatisfactory level, Tropic Asphalts could consider increasing the capacity of the fan.

If all the above items and equipment have been addressed, the following methods for increasing the stack velocity can be considered:

- Above the main outlet, install a section of stack that is of smaller diameter (eg, a 'cone'). A preliminary calculation by RCA showed that the internal diameter of the new section would need to be 1.14m maximum, to achieve an exit velocity of 15 m/s. *Important note: a reduction in diameter below 1.0m should be treated with caution and checked with the supplier of the stack extension. The change in the stack cross-sectional area may result in additional problems such as an adverse pressure drop.*
- Install an extension piece to the main stack at the same internal diameter as the existing stack (1.42m). RCA recommends that this extension is approximately 5 metres.

We would be pleased to carry out any further environmental investigations to assist you in increasing the main stack velocity and improving the dispersion of odours:

- A flow/velocity survey along the ductwork that services the main stack.
- Odour dispersion modelling. Through dispersion modelling, RCA can provide more detailed recommendations to reduce the odours at your site boundaries.

Yours faithfully
RCA AUSTRALIA

Martin Belk
Associate Environmental Engineer

REFERENCES

[1] Australian Standard AS/NZS4323.3:2001- 'Determination of Odour Concentration by Dynamic Olfactometry'.

[2] NSW DECC Approved Methods for the modelling and assessment of Air Pollutants in NSW, 2005.

Appendix A

Laboratory Test Results - Odour

THE ODOUR UNIT

Aust. Technology Park
Locomotive Workshop
Suite 16012
2 Locomotive Street
Eveleigh NSW 2015

Phone: +61 2 9209 4420
Facsimile: +61 2 9209 4421
Email: tschulz@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 165 061

Accreditation Number: 14974

Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	RCA Australia	Telephone	(02) 4902 9221
Contact	M. Belk	Facsimile	-
Sampling Site	Undisclosed	Email	martinb@rca.com.au
Sampling Method	Drum & Pump	Sampling Team	RCA Australia

Order details:

Order requested by	M. Belk	Order accepted by	J. Schulz
Date of order	10/11/2014	TOU Project #	N1865R
Order number	4000444	Project Manager	J. Schulz
Signed by	M. Belk	Testing operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. NATA accredited for compliance with ISO/IEC 17025 Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V05
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V05: $r = 0.2635$ (April 2014) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V05: $A = 0.1843$ (April 2014) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Friday, 07 November 2014

Panel Roster Number: SYD20141107_096

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LIMITED

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20141107_096

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)
Trop - 1	SC14680	06/11/2014 0730hrs	07/11/2014 1126hrs	4	8	-	-	235	235	N/A
Trop - 2	SC14681	06/11/2014 0751hrs	07/11/2014 1158hrs	4	8	-	-	118	118	N/A
Trop - 3	SC14682	06/11/2014 0841hrs	07/11/2014 1224hrs	4	8	-	-	790	790	N/A

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:
1. The collection of Isolation Flux Hood (IFH) samples and the calculation of the Specific Odour Emission Rate (SOER).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd. have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20141107_096	50,000	$20 \leq \chi \leq 80$	1,024	49	Yes

Comments

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd. Any attachments to this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.

END OF DOCUMENT

AIR QUALITY AUDIT
COLAS TOMAGO NSW SITE

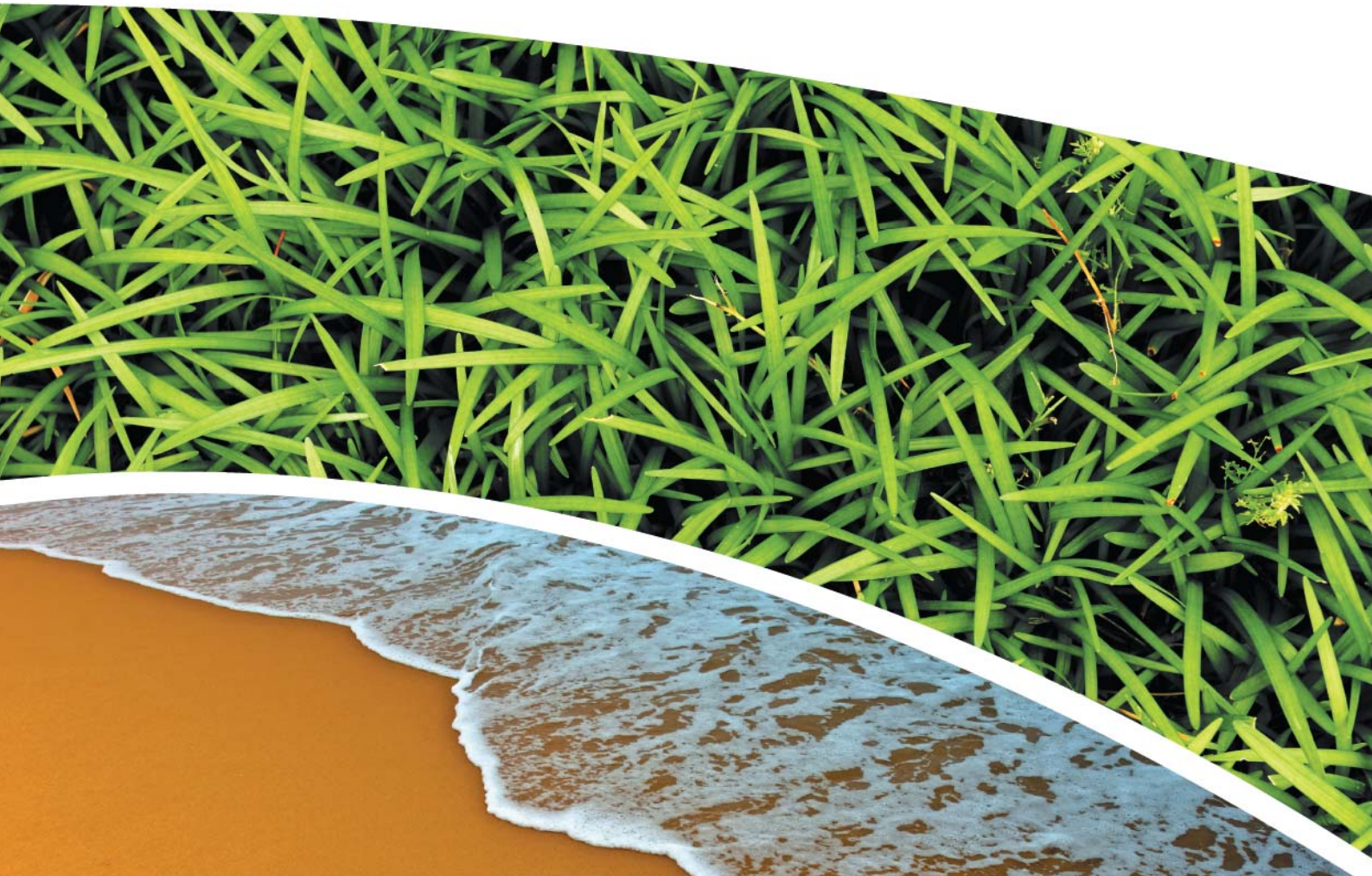
Prepared for COLAS NSW Pty Ltd

Prepared by RCA Australia

RCA ref 12857a-702/0

July 2019

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL



RCA AUSTRALIA
ABN 53 063 515 711

92 Hill Street, CARRINGTON NSW 2294

Telephone: +61 2 4902 9200
Facsimile: +61 2 4902 9299
Email: administrator@rca.com.au
Internet: www.rca.com.au

This document is and shall remain the property of RCA Australia. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission supplied at the time of proposal. Unauthorised use of this document in any form whatsoever is prohibited.

DOCUMENT STATUS						
Rev No	Comment	Author	Reviewer	Approved for Issue (Project Manager)		
				Name	Signature	Date
/0	Final	M Belk	F Brooker	M Belk	Mark Belk	23.07.19

DOCUMENT DISTRIBUTION				
Rev No	Copies	Format	Issued to	Date
/0	1	Electronic (email)	Nigel Little, Colas NSW Pty Ltd, NLittle@colas.com.au	23.07.19

bsi. ISO 9001 Quality Management

bsi. AS/NZS 4801 Occupational Health and Safety Management

Contents

1 INTRODUCTION AND BACKGROUND 1

2 AIR EMISSIONS AND TESTING PROGRAMME 2

3 SUMMARY OF AIR MONITORING RESULTS 2

3.1 STACK DUST EMISSIONS 2

3.2 AMBIENT DUST EMISSIONS 3

4 AIR QUALITY COMPLAINTS 4

5 CONCLUSIONS 5

6 LIMITATIONS 5

ATTACHMENTS 6

REFERENCES 6

RCA ref 12857a-702/0

23 July 2019

Colas NSW Pty Ltd
25 – 27 Kennington Drive
TOMAGO NSW 2322

Attention: Mr Nigel Little

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Sound & Vibration
Occupational Hygiene

AIR QUALITY AUDIT
COLAS NSW PTY LTD, TOMAGO NSW SITE

1 INTRODUCTION AND BACKGROUND

Colas NSW Pty Ltd (Colas, and previously known as Tropic Asphalt Pty Limited) requested RCA Australia (RCA) to carry out an Air Quality Audit for their Tomago site. This Audit is required in Schedule 3 of the NSW Department of Planning's Project Approval (Ref [1]), Item 6:

> "*Within 6 months of the commencement of operations, during a period in which the project is operating at normal capacity, the Proponent shall conduct an air quality audit of the project to the satisfaction of the DECC and Director-General. This audit shall: a) be undertaken by a suitability qualified and experienced person; b) assess whether the project is complying with the relevant air quality assessment criteria in this approval; and c) provide details of any complaints received on the air quality impacts of the project, and any action taken to respond to these complaints*."

In addition, RCA understands that Colas received correspondence on 7/9/18 from the NSW Department of Planning regarding the Air Quality Audit:

> "*It is noted that the Air Quality Audit will not be complete until 12 months of data is collected (March 2019). Please submit the completed Air Quality Audit, in accordance with Schedule 3, Condition 6, to the Department by 31 May 2019. Please ensure that the site's contribution is calculated when comparing to the air quality criteria at any sensitive receivers (Schedule 3, Condition 3)*".

For the purpose of this audit, RCA understands the following aspects to mean:

- "Commencement of operations*"* – after December 2007 (Ref [1]).

- "Air quality" includes the emissions as specified within Items 2 and 3 of the Project Approval (Ref [1]) only. As such RCA has not considered odour.

In addition, RCA have interpreted the NSW Department of Planning comment "*site's contribution is calculated, …* " as meaning the air emission concentrations as measured, and calculated as part of the air testing programme (see Section 2 below).

Note that although this Air Quality Audit was not completed within six (6) months of "commencement of operations" as specified in the Project Approval (Ref [1]), the audit was aimed to comply with the NSW Department of Planning's instructions dated 7/9/18, ie. once 12 months' data was collected. Also note that RCA carried out this audit by way of a desktop assessment of the air emissions data collected prior to the time of this audit, and not by carrying out any other air emissions monitoring or dispersion modelling of air emissions.

2 AIR EMISSIONS AND TESTING PROGRAMME

For the purposes of this assessment, RCA audited the air emissions monitoring results for dust (particulates) and for the components specified in Items 2 and 3 of the Project Approval (Ref [1]), namely:

- Total Suspended Particulates (TSP).
- Particulate matter < 10 Microns (PM_{10}).

For these dust components, Colas undertook air emissions testing on a regular basis (usually monthly) and under two (2) broad types of air testing to satisfy the conditions of their Environment Protection Licence (EPL, Ref [2]):

- *Stack* air emissions testing – from the main exhaust stack. This has been completed on the dates as shown in **Table 1**.
- *Ambient* air emissions testing – from locations at ground level within the Tomago site. This was carried out on a monthly basis.

All air monitoring was conducted in accordance with NSW EPA approved test methods.

3 SUMMARY OF AIR MONITORING RESULTS

3.1 STACK DUST EMISSIONS

Item 2 of the Project Approval (Ref [1]) requires:

> "*The Proponent shall ensure that the stack emissions from the project comply with the relevant standards of concentrations under the Protection of the Environment Operations Act, 1997*. "

A summary of the stack emissions testing required under Colas' Environmental Protection Licence is shown in **Table 1** below. Note that this includes all test results available to RCA since the year 2010 and carried out by RCA.

Table 1 *Summary of Particulate Emission Monitoring Analysis Results - TSP and PM_{10}.*

Testing date on site	TSP concentration (criterion 50*)	PM_{10} concentration #
9/3/10	28.3	19.3
30/5/12	27.0	12.0
10/7/14	**141.0**	13.0
11/10/16	4.4	0.6
14/12/17	10.6	0.2

All units in mg/m^3.

Bold indicates results in excess of criterion.

All concentrations expressed at standard conditions

* Concentration limit under Protection of the Environment Operations (Clean Air) Regulation 2010, for scheduled premises and commencement of operation, on or after 1 September 2005 (i.e. "Group 6") as a result of an environment protection licence granted under the Protection of the Environment Operations Act 1997 pursuant to an application made on or after 1 September 2005.

There are no general limits for fine particulate emissions including PM_{10} in NSW however they may appear in the Environmental Protection Licence (EPL) for the specific plant. At the time of completing this audit, RCA were not aware of a licence limit for PM_{10} from the main stack at the Colas Tomago site, and it could not be found in the site EPL (Ref [2]).

In summary, the stack emission limit for TSP was only exceeded on one occasion - on the 10/7/14 a measured concentration of 141.0 mg/m^3 compared with a limit of 50.0 mg/m^3.

Although there is no stack emission limit for PM_{10} from RCA's experience, the usual PM_{10} stack emissions range is between 10 to 50 mg/m^3. Taking this aspect into account, the PM_{10} concentrations shown in **Table 1** are considered low.

3.2 AMBIENT DUST EMISSIONS

Schedule 3 of Project Approval (Ref [1]) stipulates long-term impact assessment criteria for deposited dust and these are reproduced in **Table 2** and correspond to a rolling annual average deposited dust concentration at each monitoring location. It is noted that the criteria apply to sensitive receivers.

Table 2 *Deposited Dust Impact Assessment Criteria*

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust (insoluble solids)	Annual	2 g/m^2.month	4 g/m^2.month

Schedule 3 of Project Approval (Ref [1]) also stipulates long-term (rolling annual average) impact assessment criteria for TSP and PM_{10} concentrations. A short-term (24-hour average) impact assessment criterion is also applicable for PM_{10} concentrations. The TSP and PM_{10} impact assessment criteria are reproduced in **Table 3** below.

Table 3 *Particulate Impact Assessment Criteria*

Pollutant	Averaging Period	Maximum total deposited dust level
TSP	Annual	90 µg/m^3
PM_{10}	Annual	30 µg/m^3
	24 hour	50 µg/m^3

RCA reviewed the particulate monitoring data collected at the Colas Tomago site since monitors were established in November 2017. It is noted that all monitoring locations are within the Colas Tomago site, and not at the nearest residences which is considered to represent a conservative assessment of potential impact at sensitive receptors.

RCA's review indicates that most of the results were above the relevant criteria (short and long term) *if applied at the site boundaries*. There has been no monitoring at sensitive receptors.

It is noted that the Project Approval (Ref [1]) does not specify any sensitive receptor for the purpose of determining compliance with the relevant criteria. There are houses to the north, south east and west of the site, and a caravan park is located to the south west of the site. The minimum distance between these locations and the Colas Tomago site is approximately 400m.

Noting that there has been no air dispersion modelling to predict ground level particulate emission concentrations at the nearest houses and caravan park, in RCA's opinion and based on previous experience it is very unlikely that the dust levels at the nearest receivers generated from the Colas Tomago activities exceed the relevant Impact Assessment Criteria for dust. All air emissions are known to diminish over distance; the distance to the nearest house is 400m. It is considered likely that dust concentrations would decrease to levels that not only are lower than those recorded by the monitors within the Tomago site, but also to levels below the impact assessment criteria (short and long term). Air dispersion modelling and/or the placement of monitors at the nearest houses would need to be carried out to confirm this.

4 AIR QUALITY COMPLAINTS

Item 6c of the Project Approval (Ref [1]) requires:

> "*provide details of any complaints received on the air quality impacts of the project, and any action taken to respond to these complaints*"

RCA checked with Colas and for any dust emission complaints and Colas have:

- A Complaint register and a complaint form that is filled out by Colas management personnel at the Tomago site, and
- A formal Complaint Register as part of Colas' Management System Register.

Both of these documents are attached to this report.

Based on review of these documents, two (2) complaints have been received in the period between 2013 and 2018 relating to dust:

- A “dust/fume” complaint on 29/10/14. This complaint was originally recorded by personnel as “dust/fume”, but subsequently transferred to the formal register as an “odour” complaint and appropriate actions were taken to address *odour* issues (refer to the **Attachment** for further details). RCA have mentioned this complaint in this audit to demonstrate that Colas took appropriate action at the time, in case the source of the complaint was dust in origin, for example wetting down of stockpiles and the receival pit was cleaned out.
- A dust complaint on 30/1/18. The complainant reported that dust was being visibly produced from the Tomago site. Colas took action by ceasing operations during high wind conditions and by using additional water carts and sprays (refer to the **Attachment** for further details).

5 CONCLUSIONS

This Air Quality Audit has been undertaken on behalf of Colas to address the requirements of the Project Approval (Ref [1]).

RCA’s found that Colas have complied with most aspects of the approval conditions, namely:

- *whether the project is complying with the relevant air quality assessment criteria in this approval):* The results of the *stack testing* for dust emissions complied with the concentrations under Protection of the Environment Operations (Clean Air) Regulation 2010. The results of the ambient testing for air emissions at the site boundaries exceed the impact assessment criteria; however, in RCA’s opinion and experience, the relevant impact assessment criteria for dust are unlikely to be exceeded at the nearest sensitive receptors (houses and caravan park). The absence of dust complaints (except for one received in January 2018) is considered to support this finding. Air dispersion modelling and/ dust monitoring at the nearest houses would need to be carried out to confirm this.
- *provide details of any complaints received on the air quality impacts of the project, and any action taken to respond to these complaints:* Both of these details regarding Air Quality complaints and for dust emissions were provided and outlined in this audit.

6 LIMITATIONS

This report has been prepared for in accordance with Colas and their agreement with RCA. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of and Colas and the NSW Department of Planning for the purpose of carrying out this Air Quality Audit. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without written permission from RCA.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. Conditions can vary across any site that cannot be explicitly defined by investigation. This assessment did not include any dispersion modelling for dust emissions, as this was considered outside the scope of this assessment and for current operations.

Yours faithfully
RCA AUSTRALIA

Martin Belk
Associate Environmental Engineer

Fiona Brooker
Environmental Services Manager

ATTACHMENT

Complaints Register Documents

REFERENCES

[1] Project Approval for Tropic Asphalt Pty Limited, Kennington Drive Tomago NSW under Section 75J of the NSW Environmental Planning and Assessment Act 1979, NSW Department of Planning, 12th December 2007.

[2] Environmental Protection Licence (EPL) no. 12806, Tropic Tomago Pty Ltd.

COMPLAINT FORM

Management System Form

tropicasphalts

Project/Site Location: TOMAGO YARD 31, Complaint No.: 2

Date: 21/6/17 Time: 2:30 Type of Communication: ☐ Written ☑ Verbal ☐ Other:

Complainant Details

Name: ANNISA MOORE. Organisation: EPA

Address:

Telephone: Mobile: 0428751998 email:
0409 380 888

Complaint Details (How, When and Who was involved)

SITE VISIT - VISUAL INSPECTION:
- MATERIAL ON ROAD WAY - IN GUTTER,
- DUST LEAVING SITE.
- MATERIAL IN YARD 31 - INQUIRY RE SOURCE & TYPE.
+ LICENCE REQUIREMENTS

Corrective Action (How are you going to rectify/address the current issue?)

① SHOVEL OUT GUTTERS, SWEEP UP BULK + WET DOWN.
② RUN VAC TRUCK OVER ROADWAY

Action By: Action Date:

Preventive Action (How are you going to prevent it from happening again in the future?)

Distribution: ☐ Internal(Who): ☐ Client ☐ Supplier ☐ Authority:

Comments (Project Manager / Operations Manager)

Signature: Date:

COMPLAINT REGISTER

Management System Register

tropicasphalts

Project/Contract/Site Location: Tomago

Page: of

Complaint No.	Date	Complainant	Type of Communication	Complaint Details (summary)	Corrective Action	Action Date	Action By (who)	Action Completion Date	Comments
1	24/10/[illegible]	[illegible]	PHONE CALL	DUST FUMES	WET DOWN SEE NEXT FORM		NL	1/11/17	
2	21/6/17	EPA	PHONE/SOK	DUST/WASH	WET DOWN SWEEP UP	21/6/17			TOK

Note: the Complaint register may be presented in a spreadsheet/database format

COMPLAINT FORM

Management System Form

tropicasphalts

Project/Site Location: TOMAGO Complaint No. 1

Date: 29/10/14 Time: 9.30 Type of Communication: ☐ Written ☑ Verbal ☐ Other:

Complainant Details

Name: STEVE CLAIR Organisation: EPA -

Address: NEWCASTLE.

Telephone: 49086850 Mobile: email:

Complaint Details (How, When and Who was involved)

* PASSED ON COMPLAINT FROM BUSINESS IN SURROUNDING AREA - DUST/FUMES?
9.30AM

Corrective Action (How are you going to rectify/address the current issue?)

* WET DOWN STOCKPILES, WATDOWN & RE SWEEP YARD.
* CHECK EXHAUST SYSTEM. - PARTIAL BLOCKAGE FOUND AT PUG MILL -
* CLEANED RECEIVAL PIT. - DUCT CLEANERED OUT.

Action By: MATT WEBS. Action Date: 29/10/1

Preventive Action (How are you going to prevent it from happening again in the future?)

KEEP SHUTE CLEAN

Distribution: ☑ Internal(Who): ☐ Client ☐ Supplier ☐ Authority:

Comments (Project Manager / Operations Manager)

Signature: Date: 1/11/14

COMPLAINT REGISTER

Management System Register

tropicasphalts

Project/Contract/Site Location: Page: of

Complaint No.	Date	Complainant	Type of Communication	Complaint Details (summary)	Corrective Action	Action Date	Action By (who)	Action Completion Date	Comments
1	29/10/14	Perfab	Phone / Vebal	Odour complaint	Review operations of the day on site Canvased local sites. Discussed operations of site with Staff at prefab. Provided copy of - 1. Environmental assessment of the operation 2. copy of Appendix H Air quality impact assessment of the operation MSDS sheet of Asphaltic Concrete (Hotmix)	30/	Nigel Little		Follow-up Odour test conducted by RCA. Held o record

Complaint No.	Date	Complainant	Type of Communication	Complaint Details (summary)	Corrective Action	Action Date	Action By (who)	Action Completion Date	Comments
2	30/1/18	EPA	Phone +meeting With EPA	Description of Incident: The caller is affected by excessive black dust and tar particles coming from the premises of EPL12806. The dust is covering parked vehicles across the road, into office, on buildings and on Kennington Drive. The caller advises that even though the licensee uses a sweeper every morning, the Bitumen pre-mix or hot-mix production activity produces excessive dust	Review operation on site, Checked operation records of plant including load out times By way of clarification Provided to EPA - the product used on site is bitumen not tar Primarily AR450 bitumen Asphaltic cement production does not use Tar Product. EPA provided with details of the operation	31/1/18	Michael Baker	31/1/18	We have identified an operation on the morning of the 31st where reclaimed asphalt material was being moved in the yard at 33 Kennington drive. The operation was ceased due to the high wind by the staff on site Additional use of water card and sprays.

Project/Contract/Site Location: Page: of

Complaint No.	Date	Complainant	Type of Communication	Complaint Details (summary)	Corrective Action	Action Date	Action By (who)	Action Completion Date	Comments
				all day and night sometimes with visible cloud of dust blowing across. Today 31/01/2018 the dust is excessive and it is windy. Incident Address					

COMPLAINT REGISTER

Management System Register

tropicasphalts

Project/Contract/Site Location: Page: of

Complaint No.	Date	Complainant	Type of Communication	Complaint Details (summary)	Corrective Action	Action Date	Action By (who)	Action Completion Date	Comments

Note: the Complaint register may be presented in a spreadsheet/database format

RCA-LE ref 14586-401/0

20 November 2019

COLAS New South Wales Pty Ltd
25-27 Kennington Drive
TOMAGO NSW 2322

Attention: Mr Craig Aaltonen

REPORT COMPILED FOR
COLAS NEW SOUTH WALES PTY LTD
DETAILING THE ANALYSIS OF
PARTICULATE EMISSION MONITORING
TOMAGO (COLAS PLANT) NSW
31 OCTOBER 2019

This report must not be reproduced except in full.

Results or figures from this report must not be used without acknowledgment.

---

1 GENERAL COMMENTS

Job number: 14586

Client Order Number: TBA

Date Samples Received: 31/10/2019.

Samples received were sampled and analysed by RCA Laboratories - Environmental.

2 SAMPLING AND ANALYTICAL PROCEDURES

The analytical procedures used by RCA Laboratories - Environmental are based on established internationally recognised procedures such as APHA and Australian Standards. Analytical test methods are detailed in the table below.

ANALYSIS	METHOD	UNITS
Determination of Total Particulate Matter	ENV-LAB034	mg/m^3

Sampling and analysis is performed by RCA Laboratories – Environmental's internal procedure which fulfils the requirements of the NSW Department of Environment and conservation – Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, (January 2001) Test Method 15 - Determination of Total Particulate Matter.

This method incorporates:

- Test Method 1 - Selection of Sampling Positions (as outlined in Australian Standard AS4323.1 - 1995); and
- Test Method 2 - Isokinetic Sampling Method (as outlined in Australian Standard AS4323.2 - 1995).

Moisture content is determined by wet/dry bulb thermometer.

In addition, the sampling for particulate matter less than a diameter of 10 microns ("PM10") is carried out in accordance with the NSW Department of Environment and Conservation - Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, (January 2001) Test Method OM-4 - Fine Particulates (PM_{10}).

This method incorporates the USEPA Method No. 201A - Determination of PM10 emissions, constant sampling rate procedure.

3 AIR QUALITY MONITORING RESULTS

3.1 PARTICULATE EMISSION MONITORING

A total of two samples were collected on 31 October 2019. Particulate emission monitoring analysis results are shown in **Tables 1** and **2**.

- Average Velocity: 8.5 m/s at NTP.
- Discharge Volume: 33,039 m^3/h at NTP.

Sampling from the main stack was between 8:10 and 9:47 hrs on 31/10/2019.

The two sampling points available for sampling at the Tomago main stack for manual isokinetic sampling of particulates comply with Australian Standard AS4323.2 -1995.

Table 1 *Particulate Emission Monitoring Analysis Results Total (TSP)*

ANALYSIS	UNITS	SAMPLE 1
Sample Number	-	N1
Date Sampled	-	31/10/2019
Sample Duration	-	50 min
Sample Volume	m^3 at NTP	0.492
Gas Density Factor	-	0.94
Water Vapour	%	6.7
Particulate Matter	**mg/m^3**	**39.4**

Table 2 *Particulate Emission Monitoring Analysis Results* (**PM_{10}**)

ANALYSIS	UNITS	SAMPLE 2
Sample Number	-	05-09
Date Sampled	-	31/10/2019
Sample Duration	-	30 min
Sample Volume	m^3 at NTP	0.550
Gas Density Factor	-	0.94
Water Vapour	%	6.7
Particulate Matter	**mg/m^3**	**5.6**

Appendix B contains details of pre and post pitot traverse readings and other measurements.

4 QUALITY CONTROL

4.1 ANALYSIS BLANK

A blank thimble or filter paper is taken to the sampling event and is used to provide a measure of the field conditions experienced during the sampling event. The blank is analysed using the same methods as those used to analyse the collected samples.

Type	Sample Filter Number	Filter Weight Initial (g)	Filter Weight Final (g)	Calculated Weight (g)
Total (TSP) Thimble	B6	57.9007	57.9087	0.0080
PM_{10} Filter	07-09	15.1993	15.1991	<0.0001

Please contact the undersigned if you have any queries on the above.

Yours sincerely

Martin Belk
Associate Environmental Engineer
RCA Australia Pty Ltd trading as
RCA Laboratories - Environmental

Laura Schofield
Environmental Laboratory Manager
RCA Australia Pty Ltd trading as
RCA Laboratories - Environmental

Appendix A

Summary of Emission Sampling

Summary of Emission Sampling

Stack sampling date 31 October 2019

Type	Average Particulate Matter (mg/m^3)	Technician	Supervisor
Total (TSP)	39.4	S King	M Belk
PM_{10}	5.6	S King	M Belk

Appendix B

Pitot Readings and Measurements

APPENDIX 2 - Total (TSP) Testing

APPENDIX 2 - Total (TSP) Testing

Date	31/10/19	
Identification	Tomago	
Barometric Pressure	100.9	KPa
Stack Temperature	120	^{0}C
Pilot Tube Factor	0.73	
Stack Diameter	1420	mm
Stack Pressure (static)	2	mm

Gas Analysis

	H_2O	7.3	1.31
	CO_2	0.0	0.00
	O_2	0.0	0.00
Balance	N_2	100.0	25.96

Gas Density	=	27.27	27.27
Gas Density Factor	=	0.94	

Gas Density Air = 28.95

Pitot Traverse Readings

1	5.00	mm	2.24
2	6.00	mm	2.45
3	6.00	mm	2.45
4	6.00	mm	2.45
5	6.50	mm	2.55
6	6.00	mm	2.45
7	6.00	mm	2.45
8	6.50	mm	2.55
9	6.00	mm	2.45
10	5.00	mm	2.24
11	0.00	mm	0.00
12	0.00	mm	0.00
13	0.00	mm	0.00
14	0.00	mm	0.00
15	0.00	mm	0.00
16	0.00	mm	0.00
	sum sqrt =		24.27
	Av sqrt =		2.43
	Av Pitot Pressure =		5.89 mm

Post Pilot Traverse Readings

1		mm
2		mm
3		mm
4		mm
5		mm
6		mm
7		mm
8		mm
9		mm
10		mm
11		mm
12		mm
13		mm
14		mm
15		mm
16		mm

Sample No 1

Sample Temperature	27.5	^{0}C
Sample Moisture	6.7	%
Sample Pressure	364	Pa
Sample Volume	0.583	M^3
Sample Weight	0.0194	gms

APPENDIX 2 - PM_{10} Testing

Date	31/10/19	
Identification	Tomago	
Barometric Pressure	100.9	KPa
Stack Temperature	120	°C
Pilot Tube Factor	0.76	
Stack Diameter	1420	mm
Stack Pressure (static)	4	mm

Gas Analysis

	H_2O	7.6	1.36
	CO_2	0.0	0.00
	O_2	0.0	0.00
Balance	N_2	100.0	25.88

Gas Density	=	27.24	27.24
Gas Density Factor	=	0.94	

Gas Density Air = 28.95

Pilot Traverse Readings

				Post Pilot Traverse Readings		
1	5.00	mm	2.24	1		mm
2	6.00	mm	2.45	2		mm
3	6.00	mm	2.45	3		mm
4	6.00	mm	2.45	4		mm
5	6.50	mm	2.55	5		mm
6	6.00	mm	2.45	6		mm
7	6.00	mm	2.45	7		mm
8	6.50	mm	2.55	8		mm
9	6.00	mm	2.45	9		mm
10	5.00	mm	2.24	10		mm
11	0.00	mm	0.00	11		mm
12	0.00	mm	0.00	12		mm
13	0.00	mm	0.00	13		mm
14	0.00	mm	0.00	14		mm
15	0.00	mm	0.00	15		mm
16	0.00	mm	0.00	16		mm
	sum sqrt =		24.27			
	Av sqrt =		3.47			
	Av Pitot Pressure =		12.02	mm		

Sample No 1

Sample Temperature	30.6	°C
Sample Moisture	6.7	%
Sample Pressure	494	Pa
Sample Volume	0.658	M^3
Sample Weight	0.0031	gms