RivCott 2016
RivCott Pty Ltd
22-Jan-2016
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RivCott Carrathool Cotton Gin Emissions Monitoring

January 2016

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January 2016

Client: RivCott Pty Ltd

ABN: 14165446837

Prepared by

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AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

Quality Information

Document RivCott Carrathool Cotton Gin Emissions Monitoring

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Prepared by Dylan Turnbull

Reviewed by Chad Whitburn AECOM Approved Signatory

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	22-Jan-16	Final Report for Issue	Chad Whitburn Associate Director - Air Quality	

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List of Tables

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1.0 Introduction

AECOM was appointed by RivCott Pty Ltd to conduct air emissions testing of the Unloading Fan: 1A-1 Cyclone (EPL Point 1) and the Feeder Dust cyclone (EPL Point 14) at the Carrathool, NSW site. The testing is a requirement of their Environmental Protection Licence, number 20717.

Testing was conducted from 5-6 January 2016 to investigate emission concentrations for the following parameters:

- Total Particulate.

Laboratory analysis was conducted by the following laboratory for the specified tests:

Steel River Testing NATA accreditation number 18079, performed the following analysis detailed in report numbers 10418-0-M and 10418-0-P:

- Total Solid Particulates; and
- Moisture.

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2.0 Sampling Plane Requirements

The criteria for sampling planes are specified in AS 4323.1-1995 (R2014).

Table 1 Criteria for Selection of Sampling Planes (AS 4323.1)

Type of flow disturbance	Minimum distance upstream from disturbance, diameters (D)	Minimum distance downstream from disturbance, diameters (D)
Bend, connection, junction, direction change	*>2D*	*>6D*
Louvre, butterfly damper (partially closed or closed)	*>3D*	*>6D*
Axial fan	*>3D*	*>8D (see Note)*
Centrifugal fan	*>3D*	*>6D*

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

a) The gas flow is basically in the same direction at all points along each sampling traverse;

b) The gas velocity at all sampling points is greater than 3 m/s;

c) The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15^{o} to the duct axis, when measured near the periphery of a circular sampling plane;

d) The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean;

e) The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1; and

f) The gas temperature at the sampling plane should preferably be above the dewpoint.

All sampling point locations were in compliance with AS4323.1.

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3.0 Methodology

3.1 NATA Endorsed Methods

The following methods are accredited with the National Association of Testing Authorities (NATA) (accreditation number 2778(14391)) and are approved for the sampling and analysis of gases. All sampling and analysis is conducted according to the methods in **Table 2**.

Table 2 AECOM NATA Endorsed Methods

NSW EPA Approved Methods	USEPA Methods	Method Title
AS4323.1 (NSW EPA TM-1)	USEPA (2000) Method 1	Selection of sampling positions
NSW EPA TM-2	USEPA (2000) Method 2 or 2C or USEPA (1999) Method 2F or 2G or 2H (as appropriate)	Determination of stack gas velocity and volumetric flow rate (type S pitot tube)
AS4323.2 (NSW EPA TM-15)	USEPA (2000) Method 5 under approved circumstances	Determination of total particulate matter – isokinetic manual sampling – gravimetric method
NSW EPA TM-22	USEPA (2000) Method 4	Determination of moisture content in stack gases
NSW EPA TM-23	USEPA (2000) Method 3	Gas analysis for the determination of dry molecular weight
NSW EPA TM-32	USEPA (1996) Method 10	Determination of Carbon Monoxide emissions from stationary sources
NSW EPA TM-25	USEPA (1990) Method 3A	Determination of Oxygen concentrations from stationary sources

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4.0 Sampling Location

4.1 Sampling Location Summary

Table 3 provides a summary of the locations sampled by AECOM on 5-6 January 2016.

Table 3 Sampling Location Summary

Discharge Description	Unloading Fan: 1A-1 Cyclone	Feeder Dust Cyclone
Duct Shape	Circular	Circular
Construction Material	Metal	Metal
Duct Diameter (mm)	705	705
Minimum No. Sampling Points	12	12
Sampling Ports	2	2
Min. Points/Traverse	6	6
Disturbance	Yes	Yes
Distance from Upstream Disturbance	5.5	5.5
Type of Disturbance	Bend	Bend
Distance from Downstream Disturbance	5.5	5.5
Type of Disturbance	Bend	Bend
Ideal Sampling Location	Yes	Yes
Correction Factors Applied	No	No
Total No. Points Sampled	12	12
Points/Traverse	6	6
Sampling Performed to Standard[1]	Yes	Yes

[1]AS 4323.1 Stationary source emissions Method 1 – Selection of sampling positions

D = Diameters

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5.0 Equipment Calibration

AECOM has a calibration schedule to ensure the emission testing equipment is maintained in good order and with known calibration. Equipment used in this project was calibrated according to the procedures and frequency identified in the AECOM calibration schedule. Details of the schedule and the calibration calculations are available on request.

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6.0 Results

A summary of results obtained from emissions testing performed on 5-6 January 2016 is provided in **Table 4**. Detailed results along with gas stream properties during the testing period can be found in **Tables 5-10**.

All emission concentrations are converted to standard conditions of 0°C, dry gas and 1 atmosphere pressure for comparison with appropriate guideline levels.

AECOM has a calculated limit of uncertainty in regards to results. The estimation of measurement uncertainty in source testing is conducted to provide an indication of the precision of the measurement result and a degree of confidence in the range of values the reported result may represent. The measurement of uncertainty has been calculated at ±13.6%.

Field sheets and final calculations can be referred to in **Appendix A** and analytical laboratory results are provided in **Appendix B**.

Table 4 Summary of Results, January 2016

Parameter	Units	EPL Point 1			EPL Point 14			EPL Limit
Stack ID		Unloading Fan: 1A-1			Feeder Dust			
Round		1	2	3	1	2	3	
Total Particulates	mg/m^3	6.8	9.0	5.6	12	15	18	50

Table 5 Unloading Fan: 1A-1 Cyclone (EPL Point 1), Round 1, Total Particulate Results, 5 January 2016

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	47.9	°C	321.1 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	16	m/s	
Stack gas flowrate (stack conditions)	6.3	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	5.2	m^3/s	
Total Particulate Testing			
Test Period	8:27	-	9:28
Total Particulate Mass	4.8	mg	
Gas Volume Sampled	0.711	m^3	
Total Particulate Emission*1	6.8	mg/m^3	
Total Particulate Mass Emission Rate*2	36	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	**2.3**		
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**	
Dry Molecular Weight	**28.8**	**g/g-mole**	

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

Table 6 Unloading Fan: 1A-1 Cyclone (EPL Point 1), Round 2, Total Particulate Results, 5 January 2016

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	49.6	^{o}C	322.8 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	16	m/s	
Stack gas flowrate (stack conditions)	6.2	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	5.2	m^3/s	
Total Particulate Testing			
Test Period	9:49	-	10:50
Total Particulate Mass	6.4	mg	
Gas Volume Sampled	0.708	m^3	
Total Particulate Emission*[1]	9.0	mg/m^3	
Total Particulate Mass Emission Rate*[2]	47	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	**1.2**		
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**	
Dry Molecular Weight	**28.8**	**g/g-mole**	

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

Table 7 Unloading Fan: 1A-1 Cyclone (EPL Point 1), Round 3, Total Particulate Results, 5 January 2016

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	50.2	^{o}C	323.4 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	15	m/s	
Stack gas flowrate (stack conditions)	5.9	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	4.9	m^3/s	
Total Particulate Testing			
Test Period	11:01	-	12:02
Total Particulate Mass	3.7	mg	
Gas Volume Sampled	0.662	m^3	
Total Particulate Emission*[1]	5.6	mg/m^3	
Total Particulate Mass Emission Rate*[2]	27	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	**2.7**		
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**	
Dry Molecular Weight	**28.8**	**g/g-mole**	

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

Table 8 Feeder Dust Cyclone (EPL Point 14), Round 1, Total Particulate Results, 6 January 2016

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	31.0	^{o}C	304.2 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	12	m/s	
Stack gas flowrate (stack conditions)	4.6	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	4	m^3/s	
Total Particulate Testing			
Test Period	9:30	-	10:31
Total Particulate Mass	7.1	mg	
Gas Volume Sampled	0.574	m^3	
Total Particulate Emission*[1]	12	mg/m^3	
Total Particulate Mass Emission Rate*[2]	48	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	**2.3**		
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**	
Dry Molecular Weight	**28.8**	**g/g-mole**	

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

Table 9 Feeder Dust Cyclone (EPL Point 14), Round 2, Total Particulate Results, 6 January 2016

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	33.1	^{o}C	306.3 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	12	m/s	
Stack gas flowrate (stack conditions)	4.6	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	4	m^3/s	
Total Particulate Testing			
Test Period	10:49	-	11:51
Total Particulate Mass	8.3	mg	
Gas Volume Sampled	0.537	m^3	
Total Particulate Emission*[1]	15	mg/m^3	
Total Particulate Mass Emission Rate*[2]	60	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	**2.5**		
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**	
Dry Molecular Weight	**28.8**	**g/g-mole**	

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

Table 10 Feeder Dust Cyclone (EPL Point 14), Round 3, Total Particulate Results, 6 January 2016

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	34.0	^{o}C	307.2 K
Stack pressure (average)	1010	hPa	
Stack gas velocity (average, stack conditions)	12	m/s	
Stack gas flowrate (stack conditions)	4.7	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	4	m^3/s	
Total Particulate Testing			
Test Period	12:08	-	13:10
Total Particulate Mass	9.8	mg	
Gas Volume Sampled	0.559	m^3	
Total Particulate Emission*[1]	18	mg/m^3	
Total Particulate Mass Emission Rate*[2]	72	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	**3.0**		
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**	
Dry Molecular Weight	**28.8**	**g/g-mole**	

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

Appendix A

Field Sheets (60 pages)

Appendix A Field Sheets (60 pages)

Emission Measurement Calculations Spreadsheet

RivCott

AECOM's Project Number: 60480321

Emission Source: Unloading Fan: 1A-1 Round 1

Date Sampled: 5-Jan-16

ANALYTE(S)	METHOD
Total Particulate	NSW EPA TM - 15

Observations made during testing period:

Sampling Performed By:

James Lang

Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 1
Test 1: Total Particulate

Measurement/Observations

Stack Internal Dimensions:

Diameter 705 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.39 m^2

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 5.5
No. Diameters = 7.8
Type of Upstream Disturbance: Bend
Downstream (m) = 5.5
No. Diameters = 7.8
Type of Down Stream Disturbance: Bend

Total No. of sampling points = 12
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 6
PM2.5/10= NA

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

	A	B	PM10/2.5 A	PM2.5/10 B
No.	Distance from wall	S-type Pitot distances	Distance from wall	S-Type Pitot distances
1	31	1		
2	103	73		
3	209	179		
4	496	466		
5	602	572		
6	674	644		
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 1
Test 1: Total Particulate

Sampling time start: 8:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	8:00	0	20.9	0.0
2	8:01	0	20.9	0.0
3	8:02	0	20.9	0.0
4	8:03	0	20.9	0.0
5	8:04	0	20.9	0.0
6	8:05	0	20.9	0.0
7	8:06	0	20.9	0.0
8	8:07	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.50 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 1
Test 1: Total Particulate

Sampling time start: 9:30		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	9:30	0	20.9	0.0
2	9:31	0	20.9	0.0
3	9:32	0	20.9	0.0
4	9:33	0	20.9	0.0
5	9:34	0	20.9	0.0
6	9:35	0	20.9	0.0
7	9:36	0	20.9	0.0
8	9:37	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.33 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.3 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.4 %,(wet)
H_2O:	2.33 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 1
Test 1:Total Particulate

Time :	8:00	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.149	45.0	318.2	13.8
1/2	73	0.175	45.0	318.2	15.0
1/3	179	0.175	46.0	319.2	15.0
1/4	466	0.190	46.0	319.2	15.7
1/5	572	0.195	47.0	320.2	15.9
1/6	644	0.096	47.0	320.2	11.2
2/1	1	0.135	46.0	319.2	13.2
2/2	73	0.224	47.0	320.2	17.0
2/3	179	0.238	47.0	320.2	17.6
2/4	466	0.255	47.0	320.2	18.2
2/5	572	0.275	48.0	321.2	18.9
2/6	644	0.232	48.0	321.2	17.3
Average			46.6	319.8	15.7

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 15 mm
Absolute pressure in stack (hPa) : 1011.47 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack Description No.: Unloading Fan: 1A-1 Round 1
Sample Nozzle No.: S2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x $10^{-5}m^2$
Thimble No: T18
Blank thimble No: 0

Leak Check (Pre-Sampling)
Meter start: 384.5522 Meter finish: 384.5522
Time start: 8:26 Time finish: 8:26

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 385.3248 Meter finish: 385.3248
Time start: 9:30 Time finish: 9:31

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 384.5569 Time start: 8:27
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	31	11.1	21.0	19.0		Yes
1/2	0:10:00	103	12.0	23.0	20.0		Yes
1/3	0:15:00	209	12.0	24.0	21.0		Yes
1/4	0:20:00	496	12.6	24.0	22.0		Yes
1/5	0:25:00	602	12.7	25.0	22.0		Yes
1/6	0:30:00	674	8.9	25.0	22.0		Yes
2/1	0:35:00	31	10.6	26.0	23.0		Yes
2/2	0:40:00	103	13.6	26.0	23.0		Yes
2/3	0:45:00	209	14.0	27.0	24.0		Yes
2/4	0:50:00	496	14.5	27.0	24.0		Yes
2/5	0:55:00	602	15.0	27.0	24.0		Yes
2/6	1:00:00	674	13.7	28.0	25.0		Yes
Averages				25.3	22.4	no result	

Meter Finish: 385.3242 Time Finish: 9:28
Total Condensate collected: 3 ml Silica gel No(s) used: F24

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 5-Jan-16 Client: RivCott

AECOM's Project No: 60480321 Stack/Duct Description: Unloading Fan: 1A-1 Round 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	0.7750	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	23.8	°C		
	297.0	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	0.7106	m^3		

(B) Total Particulate concentration at standard conditions

Blank thimble No.: 0 Blank weight: g

Thimble No. used: T18 Total Particulate Weight 0.0048 g

Final Total Particulate Weight (Mp1): 0.00480 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0068 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 6.8 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0068 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 6.8 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.95 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 950 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F24

V_v = 9.7 g (from laboratory report) V_w = 3 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0129

Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 2.33 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.095 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.73 m/s

(ii) Average of post-sampling velocities: 16.65 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 16.19 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 6.32 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 5.2 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.036	g/s (0°C, dry gas, 1 atm pressure)		
	=	36	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.036	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	36	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	5	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	5000	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

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Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, UNLOADING FAN: 1A-1 ROUND 1
RIVCOTT
5-Jan-16
TOTAL PARTICULATE

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	47.9	°C	321.1 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	16	m/s	
Stack gas flowrate (stack conditions)	6.3	m^3/s	
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	5.2	m^3/s	
Total Particulate Testing			
Test Period	8:27	-	9:28
Total Particulate Mass	4.8	mg	
Gas Volume Sampled	0.711	m^3	
Total Particulate Emission*1	6.8	mg/m^3	
Total Particulate Mass Emission Rate*2	36	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	2.3		
Gas Density (dry at 1 atmosphere)	1.29	kg/m^3	
Dry Molecular Weight	28.8	g/g-mole	

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

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

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Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 1
Test 1:Total Particulate

Time :	9:30	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.174	47.0	320.2	15.0
1/2	73	0.195	48.0	321.2	15.9
1/3	179	0.234	49.0	322.2	17.5
1/4	466	0.231	49.0	322.2	17.4
1/5	572	0.193	50.0	323.2	15.9
1/6	644	0.160	50.0	323.2	14.5
2/1	1	0.202	49.0	322.2	16.3
2/2	73	0.247	49.0	322.2	18.0
2/3	179	0.283	50.0	323.2	19.2
2/4	466	0.277	50.0	323.2	19.0
2/5	572	0.220	50.0	323.2	17.0
2/6	644	0.151	50.0	323.2	14.1
Average			49.3	322.5	16.7

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 8 mm
Absolute pressure in stack (hPa) : 1010.78 hPa

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

RivCott

AECOM's Project Number: 60480321

Emission Source: Unloading Fan: 1A-1 Round 2

Date Sampled: 5-Jan-16

ANALYTE(S)	METHOD
Total Particulate	NSW EPA TM - 15

Observations made during testing period:

Sampling Performed By:

James Lang

Dylan Turnbull

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 2
Test 1: Total Particulate

Measurement/Observations				
Stack Internal Dimensions:			Cross Sectional Area :	0.39 m^2
Diameter	705 mm			
OR	Length	Width		
Length/Width (mm)			Minimum No. of	
Equivalent Diameter	N/A	mm	sampling points=	12
Distance from sampling plane to nearest disturbances:			Total No. of sampling points =	12
			PM2.5/10=	NA
Upstream (m) =	5.5		No. of sampling traverses/ports sampled =	2
No. Diameters =	7.8		PM2.5/10=	NA
Type of Upstream Disturbance:	Bend		No. of sampling points on each traverse/port =	6
Downstream (m) =	5.5		PM2.5/10=	NA
No. Diameters =	7.8			
Type of Down Stream Disturbance:	Bend			

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

	A	B	PM10/2.5 A	PM2.5/10 B
No.	Distance from wall	S-type Pitot distances	Distance from wall	S-Type Pitot distances
1	31	1		
2	103	73		
3	209	179		
4	496	466		
5	602	572		
6	674	644		
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 2
Test 1: Total Particulate

Sampling time start:	9:30	Sampling port No.:	1	
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	9:30	0	20.9	0.0
2	9:31	0	20.9	0.0
3	9:32	0	20.9	0.0
4	9:33	0	20.9	0.0
5	9:34	0	20.9	0.0
6	9:35	0	20.9	0.0
7	9:36	0	20.9	0.0
8	9:37	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.50 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 2
Test 1: Total Particulate

Sampling time start: 10:55		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:55	0	20.9	0.0
2	10:56	0	20.9	0.0
3	10:57	0	20.9	0.0
4	10:58	0	20.9	0.0
5	10:59	0	20.9	0.0
6	11:00	0	20.9	0.0
7	11:01	0	20.9	0.0
8	11:02	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.25 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	78.1 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.25 %(=M2)		

Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

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Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 2
Test 1:Total Particulate

Time :	9:30	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.174	47.0	320.2	15.0
1/2	73	0.195	48.0	321.2	15.9
1/3	179	0.234	49.0	322.2	17.5
1/4	466	0.231	49.0	322.2	17.3
1/5	572	0.193	50.0	323.2	15.9
1/6	644	0.160	50.0	323.2	14.5
2/1	1	0.202	49.0	322.2	16.2
2/2	73	0.247	49.0	322.2	17.9
2/3	179	0.283	50.0	323.2	19.2
2/4	466	0.277	50.0	323.2	19.0
2/5	572	0.220	50.0	323.2	16.9
2/6	644	0.151	50.0	323.2	14.1
Average			49.3	322.5	16.6

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 8 mm
Absolute pressure in stack (hPa) : 1010.78 hPa

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Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 2
Test 1:Total Particulate

Time :	10:55	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.158	49.0	322.2	14.3
1/2	73	0.195	49.0	322.2	15.9
1/3	179	0.200	49.0	322.2	16.1
1/4	466	0.215	50.0	323.2	16.7
1/5	572	0.175	50.0	323.2	15.1
1/6	644	0.126	50.0	323.2	12.8
2/1	1	0.174	50.0	323.2	15.1
2/2	73	0.190	50.0	323.2	15.8
2/3	179	0.184	50.0	323.2	15.5
2/4	466	0.204	51.0	324.2	16.3
2/5	572	0.165	51.0	324.2	14.7
2/6	644	0.139	51.0	324.2	13.5
Average			50.0	323.2	15.2

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.5 mm
Absolute pressure in stack (hPa) : 1010.74 hPa

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack Description No.: Unloading Fan: 1A-1 Round 2
Sample Nozzle No.: S2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x $10^{-5}m^2$
Thimble No: T11
Blank thimble No: 0

Leak Check (Pre-Sampling)
Meter start: 385.3850 Meter finish: 385.3850
Time start: 9:47 Time finish: 9:48

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 386.1704 Meter finish: 386.1704
Time start: 9:53 Time finish: 9:54

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 385.3864 Time start: 9:49
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	31	11.9	28.0	26.0		Yes
1/2	0:10:00	103	12.6	29.0	26.0		Yes
1/3	0:15:00	209	13.9	30.0	27.0		Yes
1/4	0:20:00	496	13.7	32.0	28.0		Yes
1/5	0:25:00	602	12.5	33.0	30.0		Yes
1/6	0:30:00	674	11.4	34.0	30.0		Yes
2/1	0:35:00	31	12.8	34.0	30.0		Yes
2/2	0:40:00	103	14.2	34.0	31.0		Yes
2/3	0:45:00	209	15.2	34.0	31.0		Yes
2/4	0:50:00	496	15.0	35.0	32.0		Yes
2/5	0:55:00	602	13.3	34.0	32.0		Yes
2/6	1:00:00	674	11.1	34.0	32.0		Yes
Averages				32.6	29.6	no result	

Meter Finish: 386.1695 Time Finish: 10:50
Total Condensate collected: 4 ml Silica gel No(s) used: FA8

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 5-Jan-16 Client: RivCott

AECOM's Project No: 60480321 Stack/Duct Description: Unloading Fan: 1A-1 Round 2

(A) Sample gas volume at standard conditions

Metered volume (MV_3): 0.7909 m^3

Average gas meter temp. ($T_{M,2}$): 31.1 °C

304.3 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 0.7078 m^3

(B) Total Particulate concentration at standard conditions

Blank thimble No.: 0 Blank weight: g

Thimble No. used: T11 Total Particulate Weight 0.0064 g

Final Total Particulate Weight (Mp1): 0.00640 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0090 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 9.0 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0090 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 9.0 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 1.3 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 1300 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: FA8

V_v = 2.7 g (from laboratory report) V_w = 4 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0053

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0036

Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 1.25 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.28 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.081 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.62 m/s

(ii) Average of post-sampling velocities: 15.15 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.88 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 6.20 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 5.2 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.047	g/s (0°C, dry gas, 1 atm pressure)		
	=	47	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.047	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	47	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	6.5	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	6500	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, UNLOADING FAN: 1A-1 ROUND 2 RIVCOTT 5-Jan-16 TOTAL PARTICULATE			
Sampling Conditions:			
Stack internal diameter at test location	705 mm		
Stack gas temperature (average)	49.6 °C		322.8 K
Stack pressure (average)	1011 hPa		
Stack gas velocity (average, stack conditions)	16 m/s		
Stack gas flowrate (stack conditions)	6.2 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	5.2 m^3/s		
Total Particulate Testing			
Test Period	9:49	-	10:50
Total Particulate Mass	6.4 mg		
Gas Volume Sampled	0.708 m^3		
Total Particulate Emission*1	9.0 mg/m^3		
Total Particulate Mass Emission Rate*2	47 mg/s		
Regulatory Limit	50 mg/m^3		
Moisture Content (%)	1.2		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.8 g/g-mole		

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

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

Emission Measurement Calculations Spreadsheet

RivCott

AECOM's Project Number: 60480321

Emission Source: Unloading Fan: 1A-1 Round 3

Date Sampled: 5-Jan-16

ANALYTE(S)	METHOD
Total Particulate	NSW EPA TM - 15

Observations made during testing period:

Sampling Performed By:

James Lang

Dylan Turnbull

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 3
Test 1: Total Particulate

Measurement/Observations				
Stack Internal Dimensions:			Cross Sectional Area :	0.39 m^2
Diameter	705 mm			
OR	Length	Width		
Length/Width (mm)			Minimum No. of	
Equivalent Diameter	N/A mm		sampling points=	12
Distance from sampling plane to nearest disturbances:			Total No. of sampling points =	12
			PM2.5/10=	NA
Upstream (m) =	5.5		No. of sampling traverses/ports sampled =	2
No. Diameters =	7.8		PM2.5/10=	NA
Type of Upstream Disturbance:	Bend		No. of sampling points on each traverse/port =	6
Downstream (m) =	5.5		PM2.5/10=	NA
No. Diameters =	7.8			
Type of Down Stream Disturbance:	Bend			

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

	A	B	PM10/2.5 A	PM2.5/10 B
No.	Distance from wall	S-type Pitot distances	Distance from wall	S-Type Pitot distances
1	31	1		
2	103	73		
3	209	179		
4	496	466		
5	602	572		
6	674	644		
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 3
Test 1: Total Particulate

Sampling time start:	10:55	Sampling port No.:	1	
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:55	0	20.9	0.0
2	10:56	0	20.9	0.0
3	10:57	0	20.9	0.0
4	10:58	0	20.9	0.0
5	10:59	0	20.9	0.0
6	11:00	0	20.9	0.0
7	11:01	0	20.9	0.0
8	11:02	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.50 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0°C, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0°C, dry, 1 atm pressure)	

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 3
Test 1: Total Particulate

Sampling time start: 12:10		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	12:10	0	20.9	0.0
2	12:11	0	20.9	0.0
3	12:12	0	20.9	0.0
4	12:13	0	20.9	0.0
5	12:14	0	20.9	0.0
6	12:15	0	20.9	0.0
7	12:16	0	20.9	0.0
8	12:17	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.97
Moisture percentage (M2): 2.67 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.0 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.3 %,(wet)
H_2O:	2.67 %(=M2)		
Therefore, stack gas density (GD) =	1.27 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 3
Test 1:Total Particulate

Time :	10:55	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.158	49.0	322.2	14.3
1/2	73	0.195	49.0	322.2	15.9
1/3	179	0.200	49.0	322.2	16.1
1/4	466	0.215	50.0	323.2	16.8
1/5	572	0.175	50.0	323.2	15.1
1/6	644	0.126	50.0	323.2	12.8
2/1	1	0.174	50.0	323.2	15.1
2/2	73	0.190	50.0	323.2	15.8
2/3	179	0.184	50.0	323.2	15.5
2/4	466	0.204	51.0	324.2	16.4
2/5	572	0.165	51.0	324.2	14.7
2/6	644	0.139	51.0	324.2	13.5
Average			50.0	323.2	15.2

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.5 mm
Absolute pressure in stack (hPa) : 1010.74 hPa

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack Description No.: Unloading Fan: 1A-1 Round 3
Sample Nozzle No.: S2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x $10^{-5}m^2$
Thimble No: T9
Blank thimble No: 0

Leak Check (Pre-Sampling)
Meter start: 386.1744 Meter finish: 386.1744
Time start: 10:59 Time finish: 11:00
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 386.9182 Meter finish: 386.9182
Time start: 12:04 Time finish: 12:05
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 386.1768 Time start: 11:01
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	31	11.3	33.0	31.0		Yes
1/2	0:10:00	103	12.6	34.0	32.0		Yes
1/3	0:15:00	209	12.7	34.0	33.0		Yes
1/4	0:20:00	496	13.3	35.0	33.0		Yes
1/5	0:25:00	602	11.9	35.0	34.0		Yes
1/6	0:30:00	674	10.1	36.0	34.0		Yes
2/1	0:35:00	31	11.9	37.0	34.0		Yes
2/2	0:40:00	103	12.5	36.0	34.0		Yes
2/3	0:45:00	209	12.2	36.0	34.0		Yes
2/4	0:50:00	496	12.9	36.0	35.0		Yes
2/5	0:55:00	602	11.6	37.0	35.0		Yes
2/6	1:00:00	674	10.6	37.0	35.0		Yes
Averages				35.5	33.7	no result	

Meter Finish: 386.9176 Time Finish: 12:02
Total Condensate collected: 5 ml Silica gel No(s) used: K9

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 5-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Unloading Fan: 1A-1 Round 3
Test 1:Total Particulate

Time :	12:10	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.27	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.162	50.0	323.2	14.6
1/2	73	0.184	50.0	323.2	15.6
1/3	179	0.206	50.0	323.2	16.4
1/4	466	0.189	51.0	324.2	15.8
1/5	572	0.191	51.0	324.2	15.9
1/6	644	0.129	50.0	323.2	13.0
2/1	1	0.177	50.0	323.2	15.2
2/2	73	0.187	50.0	323.2	15.7
2/3	179	0.175	50.0	323.2	15.1
2/4	466	0.206	51.0	324.2	16.5
2/5	572	0.172	51.0	324.2	15.0
2/6	644	0.140	51.0	324.2	13.6
Average			50.4	323.6	15.2

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.6 mm
Absolute pressure in stack (hPa) : 1010.75 hPa

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 5-Jan-16 Client: RivCott

AECOM's Project No: 60480321 Stack/Duct Description: Unloading Fan: 1A-1 Round 3

(A) Sample gas volume at standard conditions

Metered volume (MV_3): 0.7482 m^3

Average gas meter temp. ($T_{M,2}$): 34.6 °C

307.8 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 0.6620 m^3

(B) Total Particulate concentration at standard conditions

Blank thimble No.: 0

Blank weight: g

Thimble No. used: T9

Total Particulate Weight 0.0037 g

Final Total Particulate Weight (Mp1): 0.00370 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0056 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 5.6 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0056 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 5.6 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.78 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 780 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: K9

V_v = 8.6 g (from laboratory report) V_w = 5 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0067

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0115

Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 2.67 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.087 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.17 m/s

(ii) Average of post-sampling velocities: 15.20 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.18 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 5.93 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 4.9 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.027	g/s (0°C, dry gas, 1 atm pressure)		
	=	27	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.027	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	27	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	3.8	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	3800	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

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Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, UNLOADING FAN: 1A-1 ROUND 3
RIVCOTT
5-Jan-16
TOTAL PARTICULATE

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	50.2	°C	323.4 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	15	m/s	
Stack gas flowrate (stack conditions)	5.9	m^3/s	
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	4.9	m^3/s	
Total Particulate Testing			
Test Period	11:01	-	12:02
Total Particulate Mass	3.7	mg	
Gas Volume Sampled	0.662	m^3	
Total Particulate Emission*1	5.6	mg/m^3	
Total Particulate Mass Emission Rate*2	27	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	2.7		
Gas Density (dry at 1 atmosphere)	1.29	kg/m^3	
Dry Molecular Weight	28.8	g/g-mole	

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

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

Emission Measurement Calculations Spreadsheet

RivCott

AECOM's Project Number: 60480321

Emission Source: Feeder Dust Round 1

Date Sampled: 6-Jan-16

ANALYTE(S)	METHOD
Total Particulate	NSW EPA TM - 15

Observations made during testing period:

Sampling Performed By:

James Lang

Dylan Turnbull

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 1
Test 1: Total Particulate

Measurement/Observations

Stack Internal Dimensions:

Diameter 705 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.39 m^2

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 5.5
No. Diameters = 7.8
Type of Upstream Disturbance: Bend
Downstream (m) = 5.5
No. Diameters = 7.8
Type of Down Stream Disturbance: Bend

Total No. of sampling points = 12
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 6
PM2.5/10= NA

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

	A		B	PM10/2.5 A	PM2.5/10 B
No.	Distance from wall		S-type Pitot distances	Distance from wall	S-Type Pitot distances
1	31		1		
2	103		73		
3	209		179		
4	496		466		
5	602		572		
6	674		644		
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 1
Test 1: Total Particulate

Sampling time start:	9:00	Sampling port No.:	1	
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	9:00	0	20.9	0.0
2	9:01	0	20.9	0.0
3	9:02	0	20.9	0.0
4	9:03	0	20.9	0.0
5	9:04	0	20.9	0.0
6	9:05	0	20.9	0.0
7	9:06	0	20.9	0.0
8	9:07	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.50 %(=M2)		

Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 1
Test 1: Total Particulate

Sampling time start: 10:30		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:30	0	20.9	0.0
2	10:31	0	20.9	0.0
3	10:32	0	20.9	0.0
4	10:33	0	20.9	0.0
5	10:34	0	20.9	0.0
6	10:35	0	20.9	0.0
7	10:36	0	20.9	0.0
8	10:37	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.34 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.3 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.4 %,(wet)
H_2O:	2.34 %(=M2)		

Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 1
Test 1:Total Particulate

Time :	9:00	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.127	28.0	301.2	12.4
1/2	73	0.147	29.0	302.2	13.4
1/3	179	0.138	29.0	302.2	13.0
1/4	466	0.110	29.0	302.2	11.6
1/5	572	0.120	30.0	303.2	12.1
1/6	644	0.085	30.0	303.2	10.2
2/1	1	0.096	29.0	302.2	10.8
2/2	73	0.130	29.0	302.2	12.6
2/3	179	0.134	29.0	302.2	12.8
2/4	466	0.126	30.0	303.2	12.4
2/5	572	0.101	30.0	303.2	11.1
2/6	644	0.081	30.0	303.2	10.0
Average			29.3	302.5	11.9

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 5 mm
Absolute pressure in stack (hPa) : 1010.49 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack Description No.: Feeder Dust Round 1
Sample Nozzle No.: s2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x $10^{-5}m^2$
Thimble No: T12
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 387.0078 Meter finish: 387.0078
Time start: 9:27 Time finish: 9:28

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 387.6355 Meter finish: 387.6355
Time start: 10:33 Time finish: 10:34

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 387.0094 Time start: 9:30
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	31	10.5	22.0	20.0		Yes
1/2	0:10:00	103	11.3	23.0	21.0		Yes
1/3	0:15:00	209	11.0	25.0	22.0		Yes
1/4	0:20:00	496	9.8	27.0	23.0		Yes
1/5	0:25:00	602	10.2	28.0	24.0		Yes
1/6	0:30:00	674	8.6	29.0	25.0		Yes
2/1	0:35:00	31	9.1	30.0	25.0		Yes
2/2	0:40:00	103	10.6	30.0	26.0		Yes
2/3	0:45:00	209	10.8	31.0	27.0		Yes
2/4	0:50:00	496	10.4	31.0	27.0		Yes
2/5	0:55:00	602	9.3	32.0	28.0		Yes
2/6	1:00:00	674	8.4	33.0	29.0		Yes
Averages				28.4	24.8	no result	

Meter Finish: 387.6349 Time Finish: 10:31
Total Condensate collected: 5 ml Silica gel No(s) used: G100

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Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 1
Test 1:Total Particulate

Time :	10:30	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.101	32.0	305.2	11.2
1/2	73	0.120	32.0	305.2	12.2
1/3	179	0.130	32.0	305.2	12.7
1/4	466	0.113	33.0	306.2	11.8
1/5	572	0.089	33.0	306.2	10.5
1/6	644	0.076	33.0	306.2	9.7
2/1	1	0.120	32.0	305.2	12.2
2/2	73	0.130	32.0	305.2	12.7
2/3	179	0.145	33.0	306.2	13.4
2/4	466	0.119	33.0	306.2	12.1
2/5	572	0.113	33.0	306.2	11.8
2/6	644	0.085	33.0	306.2	10.3
Average			32.6	305.8	11.7

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.5 mm
Absolute pressure in stack (hPa) : 1010.74 hPa

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 6-Jan-16 Client: RivCott

AECOM's Project No: 60480321 Stack/Duct Description: Feeder Dust Round 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3): 0.6318 m^3

Average gas meter temp. ($T_{M,2}$): 26.6 °C

299.8 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 0.5739 m^3

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: T12

Blank weight: g

Total Particulate Weight 0.0071 g

Final Total Particulate Weight (Mp1): 0.00710 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.012 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 12 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.012 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 12 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 1.7 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 1700 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: G100

V_v = 5.3 g (from laboratory report) V_w = 5 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0067

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0071

Therefore, $B_{ws} = \dfrac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 2.34 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.156 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 11.87 m/s

(ii) Average of post-sampling velocities: 11.72 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 11.79 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 4.60 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 4.0 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.048	g/s (0°C, dry gas, 1 atm pressure)		
	=	48	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.048	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	48	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	6.8	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	6800	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, FEEDER DUST ROUND 1 RIVCOTT 6-Jan-16 TOTAL PARTICULATE			
Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	31.0	°C	304.2 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	12	m/s	
Stack gas flowrate (stack conditions)	4.6	m^3/s	
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	4	m^3/s	
Total Particulate Testing			
Test Period	9:30	-	10:31
Total Particulate Mass	7.1	mg	
Gas Volume Sampled	0.574	m^3	
Total Particulate Emission*1	12	mg/m^3	
Total Particulate Mass Emission Rate*2	48	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	2.3		
Gas Density (dry at 1 atmosphere)	1.29	kg/m^3	
Dry Molecular Weight	28.8	g/g-mole	

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

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

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

RivCott

AECOM's Project Number: 60480321

Emission Source: Feeder Dust Round 2

Date Sampled: 6-Jan-16

ANALYTE(S)	METHOD
Total Particulate	NSW EPA TM - 15

Observations made during testing period:

Sampling Performed By:

James Lang

Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 2
Test 1: Total Particulate

Measurement/Observations

Stack Internal Dimensions:

Diameter 705 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.39 m^2

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 5.5
No. Diameters = 7.8
Type of Upstream Disturbance: Bend
Downstream (m) = 5.5
No. Diameters = 7.8
Type of Down Stream Disturbance: Bend

Total No. of sampling points = 12
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 6
PM2.5/10= NA

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

No.	A Distance from wall	A S-type Pitot distances	B Distance from wall	B S-Type Pitot distances
1	31	1	PM10/2.5 A	PM2.5/10 B
2	103	73		
3	209	179		
4	496	466		
5	602	572		
6	674	644		
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 2
Test 1: Total Particulate

Sampling time start: 10:30		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:30	0	20.9	0.0
2	10:31	0	20.9	0.0
3	10:32	0	20.9	0.0
4	10:33	0	20.9	0.0
5	10:34	0	20.9	0.0
6	10:35	0	20.9	0.0
7	10:36	0	20.9	0.0
8	10:37	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.50 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0°C, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0°C, dry, 1 atm pressure)	

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 2
Test 1: Total Particulate

Sampling time start: 0:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	0:00	0	20.9	0.0
2		0	20.9	0.0
3		0	20.9	0.0
4		0	20.9	0.0
5		0	20.9	0.0
6		0	20.9	0.0
7		0	20.9	0.0
8		0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.49 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.1 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.4 %,(wet)
H_2O:	2.49 %(=M2)		

Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 2
Test 1:Total Particulate

Time :	10:30	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.101	32.0	305.2	11.2
1/2	73	0.120	32.0	305.2	12.2
1/3	179	0.130	32.0	305.2	12.7
1/4	466	0.113	33.0	306.2	11.8
1/5	572	0.089	33.0	306.2	10.5
1/6	644	0.076	33.0	306.2	9.7
2/1	1	0.120	32.0	305.2	12.2
2/2	73	0.130	32.0	305.2	12.7
2/3	179	0.145	33.0	306.2	13.4
2/4	466	0.119	33.0	306.2	12.1
2/5	572	0.113	33.0	306.2	11.8
2/6	644	0.085	33.0	306.2	10.3
Average			32.6	305.8	11.7

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.5 mm
Absolute pressure in stack (hPa) : 1010.74 hPa

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack Description No.: Feeder Dust Round 2
Sample Nozzle No.: s2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x $10^{-5}m^2$
Thimble No: T22
Blank thimble No: 0

Leak Check (Pre-Sampling)
Meter start: 387.6555 Meter finish: 387.6555
Time start: 10:47 Time finish: 10:48

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 388.2441 Meter finish: 388.2441
Time start: 11:55 Time finish: 11:56

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 387.6563 Time start: 10:49
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	31	9.4	24.0	21.0		Yes
1/2	0:10:00	103	10.2	25.0	22.0		Yes
1/3	0:15:00	209	10.6	26.0	23.0		Yes
1/4	0:20:00	496	9.8	28.0	25.0		Yes
1/5	0:25:00	602	8.7	29.0	27.0		Yes
1/6	0:30:00	674	8.1	30.0	28.0		Yes
2/1	0:35:00	31	10.2	30.0	28.0		Yes
2/2	0:40:00	103	10.6	30.0	28.0		Yes
2/3	0:45:00	209	11.2	30.0	28.0		Yes
2/4	0:50:00	496	10.1	30.0	28.0		Yes
2/5	0:55:00	602	9.8	30.0	28.0		Yes
2/6	1:00:00	674	8.6	31.0	28.0		Yes
Averages				28.6	26.2	no result	

Meter Finish: 388.2435 Time Finish: 11:51
Total Condensate collected: 3 ml Silica gel No(s) used: P8

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Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 2
Test 1:Total Particulate

Time :	12:05	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.098	33.0	306.2	11.0
1/2	73	0.129	33.0	306.2	12.6
1/3	179	0.134	33.0	306.2	12.9
1/4	466	0.106	34.0	307.2	11.5
1/5	572	0.101	34.0	307.2	11.2
1/6	644	0.073	34.0	307.2	9.5
2/1	1	0.146	33.0	306.2	13.5
2/2	73	0.141	34.0	307.2	13.3
2/3	179	0.129	34.0	307.2	12.7
2/4	466	0.111	34.0	307.2	11.8
2/5	572	0.107	34.0	307.2	11.5
2/6	644	0.094	33.0	306.2	10.8
Average			33.6	306.8	11.9

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 5.5 mm
Absolute pressure in stack (hPa) : 1010.54 hPa

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 6-Jan-16 Client: RivCott

AECOM's Project No: 60480321 Stack/Duct Description: Feeder Dust Round 2

(A) Sample gas volume at standard conditions

Metered volume (MV_3): 0.5931 m^3

Average gas meter temp. ($T_{M,2}$): 27.4 °C

300.6 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 0.5373 m^3

(B) Total Particulate concentration at standard conditions

Blank thimble No.: 0 Blank weight: g

Thimble No. used: T22 Total Particulate Weight 0.0083 g

Final Total Particulate Weight (Mp1): 0.00830 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.015 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 15 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.015 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 15 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 2.1 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 2100 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P8

V_v = 7.3 g (from laboratory report) V_w = 3 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0097

Therefore, $B_{ws} = \dfrac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 2.49 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.148 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 11.72 m/s

(ii) Average of post-sampling velocities: 11.86 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 11.79 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 4.60 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 4.0 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.06	g/s (0°C, dry gas, 1 atm pressure)		
	=	60	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.06	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	60	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	8.4	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	8400	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

EMISSION MONITORING RESULTS, FEEDER DUST ROUND 2
RIVCOTT
6-Jan-16
TOTAL PARTICULATE

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	33.1	°C	306.3 K
Stack pressure (average)	1011	hPa	
Stack gas velocity (average, stack conditions)	12	m/s	
Stack gas flowrate (stack conditions)	4.6	m^3/s	
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	4	m^3/s	
Total Particulate Testing			
Test Period	10:49	-	11:51
Total Particulate Mass	8.3	mg	
Gas Volume Sampled	0.537	m^3	
Total Particulate Emission*1	15	mg/m^3	
Total Particulate Mass Emission Rate*2	60	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	2.5		
Gas Density (dry at 1 atmosphere)	1.29	kg/m^3	
Dry Molecular Weight	28.8	g/g-mole	

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

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

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

RivCott

AECOM's Project Number: 60480321

Emission Source: Feeder Dust Round 3

Date Sampled: 6-Jan-16

ANALYTE(S)	METHOD
Total Particulate	NSW EPA TM - 15

Observations made during testing period:

Sampling Performed By:

James Lang

Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 3
Test 1: Total Particulate

Measurement/Observations	
Stack Internal Dimensions: Diameter 705 mm OR Length Width Length/Width (mm) Equivalent Diameter N/A mm	Cross Sectional Area : 0.39 m^2 Minimum No. of sampling points= 12
Distance from sampling plane to nearest disturbances: Upstream (m) = 5.5 No. Diameters = 7.8 Type of Upstream Disturbance: Bend Downstream (m) = 5.5 No. Diameters = 7.8 Type of Down Stream Disturbance: Bend	Total No. of sampling points = 12 PM2.5/10= NA No. of sampling traverses/ports sampled = 2 PM2.5/10= NA No. of sampling points on each traverse/port = 6 PM2.5/10= NA
Position of each sampling point, for each traverse:	Exclusion of any sample point numbers - comments:

	A	B	PM10/2.5 A	PM2.5/10 B
No.	Distance from wall	S-type Pitot distances	Distance from wall	S-Type Pitot distances
1	31	1		
2	103	73		
3	209	179		
4	496	466		
5	602	572		
6	674	644		
7				
8				
9				
10			Check of total points against minimum, (yes/no) - comments:	
11				
12				
13				
14				
15				
16				
17				
18				
19			General Comments:	
20				
Signed:			Checked:	

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 3
Test 1: Total Particulate

Sampling time start:	12:05	Sampling port No.:	1	
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	12:05	0	20.9	0.0
2	12:06	0	20.9	0.0
3	12:07	0	20.9	0.0
4	12:08	0	20.9	0.0
5	12:09	0	20.9	0.0
6	12:10	0	20.9	0.0
7	12:11	0	20.9	0.0
8	12:12	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.50 %(=M2)		

Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 3
Test 1: Total Particulate

Sampling time start: 0:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	0:00	0	20.9	0.0
2		0	20.9	0.0
3		0	20.9	0.0
4		0	20.9	0.0
5		0	20.9	0.0
6		0	20.9	0.0
7		0	20.9	0.0
8		0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.97
Moisture percentage (M2): 2.96 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	76.8 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.3 %,(wet)
H_2O:	2.96 %(=M2)		

Therefore, stack gas density (GD) =	1.27 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 3
Test 1:Total Particulate

Time :	12:05	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.098	33.0	306.2	11.0
1/2	73	0.129	33.0	306.2	12.6
1/3	179	0.134	33.0	306.2	12.9
1/4	466	0.106	34.0	307.2	11.5
1/5	572	0.101	34.0	307.2	11.2
1/6	644	0.073	34.0	307.2	9.5
2/1	1	0.146	33.0	306.2	13.5
2/2	73	0.141	34.0	307.2	13.2
2/3	179	0.129	34.0	307.2	12.7
2/4	466	0.111	34.0	307.2	11.7
2/5	572	0.107	34.0	307.2	11.5
2/6	644	0.094	33.0	306.2	10.8
Average			33.6	306.8	11.8

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 5.5 mm
Absolute pressure in stack (hPa) : 1010.54 hPa

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack Description No.: Feeder Dust Round 3
Sample Nozzle No.: s2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x $10^{-5}m^2$
Thimble No: N12
Blank thimble No: 0

Leak Check (Pre-Sampling)
Meter start: 388.2484 Meter finish: 388.2484
Time start: 12:06 Time finish: 12:07

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 388.8756 Meter finish: 388.8756
Time start: 13:12 Time finish: 13:13

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 388.2500 Time start: 12:08
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	31	9.2	30.0	29.0		Yes
1/2	0:10:00	103	10.5	32.0	30.0		Yes
1/3	0:15:00	209	10.7	33.0	30.0		Yes
1/4	0:20:00	496	9.5	33.0	30.0		Yes
1/5	0:25:00	602	9.3	34.0	31.0		Yes
1/6	0:30:00	674	7.9	35.0	31.0		Yes
2/1	0:35:00	31	11.2	35.0	32.0		Yes
2/2	0:40:00	103	11.0	36.0	32.0		Yes
2/3	0:45:00	209	10.5	36.0	32.0		Yes
2/4	0:50:00	496	9.7	36.0	33.0		Yes
2/5	0:55:00	602	9.5	36.0	33.0		Yes
2/6	1:00:00	674	9.0	36.0	33.0		Yes
Averages				34.3	31.3	no result	

Meter Finish: 388.8722 Time Finish: 13:10
Total Condensate collected: 2 ml Silica gel No(s) used: P5

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 6-Jan-16
Client: RivCott
AECOM's Project No: 60480321
Stack/Duct Description: Feeder Dust Round 3
Test 1:Total Particulate

Time :	13:15	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.27	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	1	0.103	34.0	307.2	11.3
1/2	73	0.129	34.0	307.2	12.7
1/3	179	0.129	34.0	307.2	12.7
1/4	466	0.113	35.0	308.2	11.9
1/5	572	0.111	35.0	308.2	11.8
1/6	644	0.080	35.0	308.2	10.0
2/1	1	0.132	34.0	307.2	12.9
2/2	73	0.136	34.0	307.2	13.1
2/3	179	0.137	34.0	307.2	13.1
2/4	466	0.119	34.0	307.2	12.2
2/5	572	0.113	35.0	308.2	11.9
2/6	644	0.104	35.0	308.2	11.4
Average			34.4	307.6	12.1

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 0 mm
Absolute pressure in stack (hPa) : 1010.00 hPa

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 6-Jan-16 Client: RivCott

AECOM's Project No: 60480321 Stack/Duct Description: Feeder Dust Round 3

(A) Sample gas volume at standard conditions

Metered volume (MV_3): 0.6284 m^3

Average gas meter temp. ($T_{M,2}$): 32.8 °C

306.0 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 0.5592 m^3

(B) Total Particulate concentration at standard conditions

Blank thimble No.: 0 Blank weight: g

Thimble No. used: N12 Total Particulate Weight 0.0098 g

Final Total Particulate Weight (Mp1): 0.00980 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.018 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 18 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.018 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 18 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 2.5 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 2500 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P5

V_v = 10.8 g (from laboratory report) V_w = 2 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0027

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0144

Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 2.96 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0^oC, wet, 1 atm pressure)
1.29 kg/m^3 (0^oC, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.144 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 11.84 m/s

(ii) Average of post-sampling velocities: 12.08 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 11.96 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 4.67 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 4.0 m^3/s (0^oC, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.072	g/s (0^oC, dry gas, 1 atm pressure)		
	=	72	mg/s (0^oC, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.072	g/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	=	72	mg/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	10	g/s (0^oC, dry gas, 1 atm pressure	7%	O_2)
	=	10000	mg/s (0^oC, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, FEEDER DUST ROUND 3
RIVCOTT
6-Jan-16
TOTAL PARTICULATE

Sampling Conditions:			
Stack internal diameter at test location	705	mm	
Stack gas temperature (average)	34.0	°C	307.2 K
Stack pressure (average)	1010	hPa	
Stack gas velocity (average, stack conditions)	12	m/s	
Stack gas flowrate (stack conditions)	4.7	m^3/s	
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	4	m^3/s	
Total Particulate Testing			
Test Period	12:08	-	13:10
Total Particulate Mass	9.8	mg	
Gas Volume Sampled	0.559	m^3	
Total Particulate Emission*1	18	mg/m^3	
Total Particulate Mass Emission Rate*2	72	mg/s	
Regulatory Limit	50	mg/m^3	
Moisture Content (%)	3.0		
Gas Density (dry at 1 atmosphere)	1.29	kg/m^3	
Dry Molecular Weight	28.8	g/g-mole	

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

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

Appendix B

Laboratory Analytical Reports (2 pages)

Appendix B Laboratory Analytical Reports (2 pages)

Steel River Testing

5/11 McIntosh Drive, Mayfield West, NSW 2304
Phone: 02 49677880

STACK EMISSION - MOISTURE REPORT

Origin: AECOM - Newcastle
Project: **60480321**

Report : 10418-0-M

Description : Stack Emission Samples
Received: 11-Jan-16

Date : 21-Jan-16

Report To : Colin Clarke
17 Warabrook Blvd, Warabrook NSW 2304

Copy to: FILE

Jar ID	Moisture (g)
F24	9.7
F99	6.1
FA7	9.8
FA8	2.7
G100	5.3
I92	10.0
K9	8.6
M23	5.9
P30	6.1
P5	10.8
P8	7.3
Z11	6.8

NATA Accredited Laboratory 18079
Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Reported By: M. Campbell
Michael Campbell

Determined in Accordance With:
Moisture content in stack gases by gravimetric using in-house M301

Steel River Testing

5/11 McIntosh Drive, Mayfield West, NSW 2304
Phone: 02 49677880

STACK EMISSION - PARTICULATES REPORT

Origin: AECOM - Newcastle
Project: **60480321**
Report : 10418-0-P

Description : Stack Emission Samples
Received: 11-Jan-16
Date : 21-Jan-16

Report To : Colin Clarke
17 Warabrook Blvd, Warabrook NSW 2304
Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
N12	Thimble	-	0.0098
N4	Thimble	-	0.0107
N6	Thimble	-	0.0087
S36	Thimble	-	0.0215
T1	Thimble	-	0.0040
T11	Thimble	-	0.0064
T12	Thimble	-	0.0071
T15	Thimble	-	0.0173
T18	Thimble	-	0.0048
T22	Thimble	-	0.0083
T25	Thimble	-	0.0250
T9	Thimble	-	0.0037

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Note : Sampled by Client

Reported By: M. Campbell
Michael Campbell

Determined in Accordance With:
Particulate matter - total in stack gases by gravimetric using in-house M300;
Acetone/Water Rinse using AS4323.2

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