1st Quarter Emissions Testing Report 2019

Liberty Recycling Hexham

NATA ACCREDITATION No. 2778 (14391)
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1st Quarter Emissions Testing Report 2019

Liberty Recycling Hexham

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1.0 Introduction

AECOM was appointed by Liberty Recycling Pty Ltd to conduct a series of measurements to determine air emissions from the Shredder Baghouse Stack (EPL Point 1) at the Hexham facility. Measurements were required for NSW EPA licence compliance (EPL No. 5345).

Testing was undertaken on 14 March 2019 to investigate emission concentrations for the following parameters:

- Fine Particulates (PM_{10});
- Total Particulate (TP); and
- Hazardous Substances (Metals) including Lead and Mercury.

Laboratory analysis was undertaken by the following laboratories which hold NATA accreditation for the specified tests:

- Steel River Testing, laboratory NATA accreditation number 18079, performed the following analysis detailed in report number 18314-0-M & 18314-0-P:
  - Total Particulate (TP);
  - Fine Particulates (PM_{10}); and
  - Moisture.
- SGS Australia Pty Ltd, NATA accreditation number 2562, performed the following analysis detailed in report number ME309936 R0:
  - Hazardous Substances (Metals).

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.

The sampling plane for EPL Point 1 was compliant with the AS4323.1.

3.0 Methodology

3.1 NATA Accredited 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. Specific details of the methods are available on request.

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	USEPA (2000) Method 1	Selection of sampling positions
AS4323.2	USEPA (2000) Method 5	Determination of total particulate matter – isokinetic manual sampling – gravimetric method
NSW EPA TM-2	USEPA (2000) Method 2	Determination of stack gas velocity and volumetric flow rate (type s pitot tube)
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 OM-5	USEPA (1997) Method 201A	Determination of PM_{10} emissions
NSW EPA TM-12,13 and 14	USEPA Method 29	Determination of metal emissions from stationary sources

All parameters are reported adjusted to 0°C at 1 atmosphere and dry gas.

3.2 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.

4.0 Sampling Location

4.1 Sampling Location Summary

Table 3 provides a summary of the location sampled by AECOM on 14 March 2019.

Table 3 Sampling Location Summary

Discharge Description	Shredder Baghouse Stack (EPL Point 1)
Duct Shape	Circular
Construction Material	Metal
Duct Diameter (mm)	760
Minimum No. Sampling Points	12
Sampling Ports	2
Min. Points/Traverse	6
Disturbance	No
Distance from Upstream Disturbance	6.6D
Type of Disturbance	Bend
Distance from Downstream Disturbance	2.6D
Type of Disturbance	Stack Exit
Ideal Sampling Location	Yes
Correction Factors Applied	No
Total No. Points Sampled	12
Points/Traverse	6
Sampling Performed to Standard[1]	Yes

[1] AS 4323.1 Section 4.1
D = Diameters

5.0 Results

A summary of air emission test results is shown in **Table 4**. Detailed results along with gas stream properties during the testing period can be found in **Table 5**. Speciated Hazardous Substances (Metals) results are presented in **Table 6**. Emission concentrations are converted to standard conditions of 0°C, dry gas and 1 atm pressure for comparison with regulatory limits.

Field sheets and final calculations recorded during the project are attached as **Appendix A**. Laboratory reports can be referred to in **Appendix B**.

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%.

Table 4 Shredder Baghouse Emission Results Summary, 14 March 2019

Parameter	Emission Concentration (EPL Point 1)	Emission Concentration Limit
Total Particulate (TP) (mg/m^3)	9.2	100
Fine Particulate (PM_{10}) (mg/m^3)	2.7	N/A
Lead (mg/m^3)	0.0052	5
Mercury (mg/m^3)	0.00021	1
Total Hazardous Substances (Metals) (mg/m^3)	0.023	N/A

Results from testing conducted on EPL Point 1 on 14 March 2019 are below the regulatory limits listed in EPL 5345.

Table 5 Fine Particulate (PM_{10}), Total Particulate and Hazardous Substance (Metals) Results, 14 March 2019

Sampling Conditions:			
Stack internal diameter at test location	760	mm	
Stack gas temperature (average)	33.5	°C	306.7 K
Stack pressure (average)	1014	hPa	
Stack gas velocity (average, stack conditions)	7.3	m/s	
Stack gas flowrate (stack conditions)	3.3	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	2.9	m^3/s	
Fine Particulate (PM_{10}) Testing			
Test Period	12:55	-	14:25
Fine Particulate (PM_{10}) Mass	2.8	mg	
Gas Volume Sampled	1.03	m^3	
Fine Particulate (PM_{10}) Emission*1	2.7	mg/m^3	
Fine Particulate (PM_{10}) Mass Emission Rate*2	7.8	mg/s	
Regulatory Limit	N/A		
Total Particulate Testing			
Test Period	12:55	-	14:25
Total Particulate Mass	9.4	mg	
Gas Volume Sampled	1.02	m^3	
Total Particulate Emission*1	9.2	mg/m^3	
Total Particulate Mass Emission Rate*2	27	mg/s	
Regulatory Limit	100	mg/m^3	
Hazardous Substances (Metals) Testing			
Test Period	12:55	-	14:25
Hazardous Substances (Metals) Mass	0.022	mg	
Gas Volume Sampled	0.956	m^3	
Hazardous Substances (Metals) Emission*1	0.023	mg/m^3	
Hazardous Substances (Metals) Mass Emission Rate*2	0.067	mg/s	
Regulatory Limit	N/A		
Moisture Content (%)	**1.9**		
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.

Table 6 Hazardous Substances (Metals) Elemental Analysis Results, 14 March 2019

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m^3)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m^3)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m^3)	Total (mg)	Total (mg/m^3)	Mass Emission Rate (mg/s)
Antimony	0.00015	0.00016	0.00015	0.00016			0.0003	0.00031	0.0009
Arsenic	<0.00046	<0.00048	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Beryllium	<0.00005	<0.000052	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Cadmium	0.00037	0.00039	<0.0002	<0.00021			0.0004	0.00042	0.0012
Chromium	0.0011	0.0012	0.00049	0.00051			0.002	0.0021	0.0061
Cobalt	<0.0001	<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Copper	0.0024	0.0025	0.003	0.0031			0.005	0.0052	0.015
Lead	0.0033	0.0035	0.0013	0.0014			0.005	0.0052	0.015
Magnesium	<0.29	<0.3	0.029	0.03			0.03	0.031	0.09
Manganese	0.0019	0.002	0.0011	0.0012			0.003	0.0031	0.009
Mercury	0.00005	0.000052	0.000048	0.00005	0.00015	0.00016	0.0002	0.00021	0.00061
Nickel	0.00084	0.00088	0.0005	0.00052			0.001	0.001	0.0029
Selenium	0.00005	0.000052	<0.0005	<0.00052			0.00005	0.000052	0.00015
Thallium	<0.0001	<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Tin	0.008	0.0084	0.0038	0.004			0.01	0.01	0.029
Vanadium	<0.00299	<0.0031	<0.0039	<0.0041			<0.0001	<0.0001	<0.00029
Zinc	<6.6	<6.9	0.023	0.024			0.02	0.021	0.061
Total Hazardous Metals*	**0.0078**	**0.0082**	**0.0036**	**0.0038**	**0.00015**	**0.00016**	**0.022**	**0.023**	**0.066**
Total Metals	**0.018**	**0.019**	**0.062**	**0.065**			**0.077**	**0.081**	**0.23**

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

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Appendix A

Field Sheets (19 pages)

Appendix A Field Sheets (19 pages)

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

OneSteel Hexham

AECOM's Project Number: 60493017

Emission Source: Shredder Stack

Date Sampled: 14-Mar-19

ANALYTE(S)	METHOD
Fine Particulate (PM10)	NSW EPA OM - 5
Total Particulate	NSW EPA TM - 15
Hazardous Substances (Metals)	NSW EPA TM - 12, 13 & 14

Observations made during testing period:

Sampling Performed By:

for Sharn Crosdale

for Sam Hamilton

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Hazardous Substances (Metals)

Measurement/Observations

Stack Internal Dimensions:

Diameter 760 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.45 m^2

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 5
No. Diameters = 6.6
Type of Upstream Disturbance: Fan Entry
Downstream (m) = 2
No. Diameters = 2.6
Type of Down Stream Disturbance: Stack Exit

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

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	PM10/2.5 A Distance from wall	PM2.5/10 B S-Type Pitot distances
1	33	3	33	3
2	111	81	111	81
3	225	195	225	195
4	535	505	535	505
5	649	619	649	619
6	727	697	727	697
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

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Hazardous Substances (Metals)

Sampling time start: 12:43		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	12:43	0	20.9	0.0
2	12:44	0	20.9	0.0
3	12:45	0	20.9	0.0
4	12:46	0	20.9	0.0
5	12:47	0	20.9	0.0
6	12:48	0	20.9	0.0
7	12:49	0	20.9	0.0
8	12:50	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.40 %

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:	77.2 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.4 %,(wet)
H_2O:	2.40 %(=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: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Hazardous Substances (Metals)

Sampling time start: 14:12		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	14:12	0	20.9	0.0
2	14:13	0	20.9	0.0
3	14:14	0	20.9	0.0
4	14:15	0	20.9	0.0
5	14:16	0	20.9	0.0
6	14:17	0	20.9	0.0
7	14:18	0	20.9	0.0
8	14:19	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.89 %

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:	77.6 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.5 %,(wet)
H_2O:	1.89 %(=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 - Pre Sampling Pitot Tube and Temperature Traverses

Date: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Hazardous Substances (Metals)

Time :	12:53	Barometric Pressure :	1014	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	3	0.038	33.0	306.2	6.9
1/2	81	0.038	33.0	306.2	6.9
1/3	195	0.041	33.0	306.2	7.1
1/4	505	0.051	33.0	306.2	7.9
1/5	619	0.046	33.0	306.2	7.6
1/6	697	0.047	33.0	306.2	7.6
2/1	3	0.045	33.0	306.2	7.5
2/2	81	0.044	33.0	306.2	7.4
2/3	195	0.043	33.0	306.2	7.3
2/4	505	0.050	33.0	306.2	7.9
2/5	619	0.029	33.0	306.2	6.0
2/6	697	0.047	33.0	306.2	7.6
Average			33.0	306.2	7.3

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -5.1 mm
Absolute pressure in stack (hPa) : 1013.50 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF FINE PARTICULATE (PM10)

Date: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack Description No.: Shredder Stack
Sample Nozzle No.: fine10
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 5.82 x $10^{-5}m^2$
Thimble No: M29
Blank thimble No: 0

Leak Check (Pre-Sampling)
Meter start: 5500.3022 Meter finish: 5500.3022
Time start: 12:46 Time finish: 12:47

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 5501.4672 Meter finish: 5501.4672
Time start: 14:29 Time finish: 14:30

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)
Meter start: 5500.3038 Time start: 12:55
Meter correction factor (GMf) : 0.9900

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	0:07:00	33	12.9	30.6	27.5	y	Yes
1/2	0:07:00	111	12.9	31.0	28.0	y	Yes
1/3	0:07:15	225	12.9	32.0	28.0	y	Yes
1/4	0:08:15	535	12.9	33.0	28.0	y	Yes
1/5	0:07:45	649	12.9	33.0	28.0	y	Yes
1/6	0:07:45	727	12.9	33.0	28.0	y	Yes
2/1	0:07:45	33	12.9	33.0	29.0	y	Yes
2/2	0:07:30	111	12.9	34.0	29.0	y	Yes
2/3	0:07:30	225	12.9	35.0	29.0	y	Yes
2/4	0:08:00	535	12.9	35.0	30.0	y	Yes
2/5	0:06:15	649	12.9	35.0	30.0	y	Yes
2/6	0:08:00	727	12.9	35.0	30.0	y	Yes
Averages				33.3	28.7	no result	

Meter Finish: 5501.4650 Time Finish: 14:25
Total Condensate collected: 0 ml Silica gel No(s) used: G024

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack Description No.: Shredder Stack
Sample Nozzle No.: s10
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 2.98 x $10^{-5}m^2$
Thimble No: N23
Blank thimble No:

Leak Check (Pre-Sampling)
Meter start: 549.7956 Meter finish: 549.7956
Time start: 12:48 Time finish: 12:49

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 549.9264 Meter finish: 549.9264
Time start: 14:31 Time finish: 14:32

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)
Meter start: 549.7978 Time start: 12:55
Meter correction factor (GMf) : 1.0000

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	0:07:30	33	11.8	29.0	27.0	y	Yes
1/2	0:15:00	111	11.8	30.0	27.0	y	Yes
1/3	0:22:30	225	12.2	30.0	28.0	y	Yes
1/4	0:30:00	535	13.5	31.0	28.0	y	Yes
1/5	0:37:30	649	13.0	31.0	28.0	y	Yes
1/6	0:45:00	727	13.0	31.0	28.0	y	Yes
2/1	0:52:30	33	12.8	31.0	28.0	y	Yes
2/2	1:00:00	111	12.7	31.0	28.0	y	Yes
2/3	1:07:30	225	12.5	32.0	29.0	y	Yes
2/4	1:15:00	535	13.5	33.0	29.0	y	Yes
2/5	1:22:30	649	10.3	32.0	29.0	y	Yes
2/6	1:30:00	727	13.0	32.0	29.0	y	Yes
Averages				31.1	28.2	no result	

Meter Finish: 550.9250 Time Finish: 14:25
Total Condensate collected: 3 ml Silica gel No(s) used: O26

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

Date: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack Description No.: Shredder Stack
Sample Nozzle No.: g61 Sample Nozzle Area (An): 2.73 x $10^{-5}m^2$
Sampling Port No.: 1 to 2 Thimble No: 0
Page No: 1 of 1 Blank thimble No:

Leak Check (Pre-Sampling)
Meter start: 656.6854 Meter finish: 656.6854
Time start: 12:50 Time finish: 12:51

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 657.7392 Meter finish: 657.7392
Time start: 14:33 Time finish: 14:34

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)
Meter start: 656.6882 Time start: 12:55
Meter correction factor (GMf) : 1.0057

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	0:07:30	33	10.9	28.0	27.0	y	Yes
1/2	0:15:00	111	10.9	29.0	27.0	y	Yes
1/3	0:22:30	225	11.2	29.0	28.0	y	Yes
1/4	0:30:00	535	12.5	30.0	28.0	y	Yes
1/5	0:37:30	649	12.0	30.0	28.0	y	Yes
1/6	0:45:00	727	12.0	30.0	28.0	y	Yes
2/1	0:52:30	33	11.8	30.0	28.0	y	Yes
2/2	1:00:00	111	11.7	30.0	28.0	y	Yes
2/3	1:07:30	225	11.5	30.0	29.0	y	Yes
2/4	1:15:00	535	12.5	31.0	29.0	y	Yes
2/5	1:22:30	649	9.5	30.0	29.0	y	Yes
2/6	1:30:00	727	12.0	30.0	29.0	y	Yes
Averages				29.8	28.2	no result	

Meter Finish: 657.7388 Time Finish: 14:25
Total Condensate collected: 2 ml Silica gel No(s) used: F21

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 14-Mar-19
Client: OneSteel Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Hazardous Substances (Metals)

Time :	14:27	Barometric Pressure :		1014	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	3	0.037	34.0	307.2	6.8
1/2	81	0.039	34.0	307.2	7.0
1/3	195	0.040	34.0	307.2	7.1
1/4	505	0.052	34.0	307.2	8.0
1/5	619	0.047	34.0	307.2	7.6
1/6	697	0.046	34.0	307.2	7.6
2/1	3	0.044	34.0	307.2	7.4
2/2	81	0.045	34.0	307.2	7.5
2/3	195	0.044	34.0	307.2	7.4
2/4	505	0.049	34.0	307.2	7.8
2/5	619	0.030	34.0	307.2	6.1
2/6	697	0.048	34.0	307.2	7.7
Average			34.0	307.2	7.3

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -4.8 mm
Absolute pressure in stack (hPa) : 1013.53 hPa

STACK ANALYSIS - PM10 CALCULATIONS

Date: 14-Mar-19 Client: OneSteel Hexham
AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

1. Gas Analysis

	%		
$\%CO_2$	0.0		
$\%O_2$	20.9		
$\%N_2+\%CO$	79.1		
Fraction Moisture Content, Bws	0.02	M_s=	0.98

2. Molecular Weight of Stack Gas (Dry Basis)

Mol. Wt. of Stack Gas (dry)	28.84
Mol. Wt. of Stack Gas (wet)	28.58

3. Absolute Stack Pressure

	Pascals	in. Hg
Barometric Pressure (Pbar)	101400	29.93
Stack Static Pressure (Pg)	101353	29.92
Absolute Stack Pressure		29.92

4. Viscosity of Stack Gas

	°C	°F
Average Stack Temp.	34.0	93.2
Average Meter Temperature:	31.0	
Stack Gas Viscosity		186.2

5. Cyclone Flow Rate

	ft^3/min	m^3/min	L/min	L/s
Cyclone Flow Rate	0.46	0.0164	16.40	0.27

6. Nozzle Velocity, Rmin and Rmax

Nozzle Number	Nozzle Diameter	Nozzle Velocity		Rmin	Rmax	Vmin	Vmin	Vmax	Vmax
	(inches)	ft/sec	m/s	[-]	[-]	ft/sec	m/s	ft/sec	m/s
0	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
1	0.133	79.69	26.23	0.756	1.230	60.27	19.77	98.03	32.16
2	0.159	55.83	18.38	0.723	1.251	40.38	13.25	69.83	22.91
3	0.166	51.67	17.01	0.713	1.257	36.83	12.08	64.94	21.31
4	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0.198	36.20	11.91	0.640	1.295	23.17	7.60	46.86	15.37
6	0.227	27.60	9.09	0.528	1.338	14.56	4.78	36.94	12.12
7	0.241	24.37	8.02	0.427	1.364	12.19	4.00	33.24	10.91
8	0.273	19.07	6.28	#NUM!	1.428	9.53	3.13	27.24	8.94
9	0.318	14.03	4.62	#NUM!	1.540	7.01	2.30	21.04	6.90
10	0.339	12.35	4.07	#NUM!	1.599	6.18	2.03	18.53	6.08
11	0.430	7.67	2.52	#NUM!	1.903	3.83	1.26	11.50	3.77

Selected Nozzle	Nozzle Diameter (inches)	Nozzle Diameter (m)	Nozzle Area (m^2)	Sample Rate (L/min)
10	0.339	0.009	0.000058	13.5

STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

Date: 14-Mar-19 Client: OneSteel Hexham
AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

7.Sampling Time Total Run Time 90 Number of points 12

Velocity Head (pitot) Pa	Vel Head in H20	Sqr Root	Dwell time mins
37.28	0.15	0.39	7.0
39.24	0.16	0.40	7.1
40.22	0.16	0.40	7.2
51.99	0.21	0.46	8.2
47.09	0.19	0.43	7.8
46.11	0.19	0.43	7.7
44.15	0.18	0.42	7.6
45.13	0.18	0.43	7.6
44.15	0.18	0.42	7.6
49.05	0.20	0.44	8.0
30.41	0.12	0.35	6.3
48.07	0.19	0.44	7.9
	Average	0.42	90.00
	Square	0.17	

Total time min	Full hours	Full minutes	Seconds
7.0	0	7	0
14.0	0	14	0
21.3	0	21	15
29.5	0	29	30
37.3	0	37	15
45.0	0	45	0
52.8	0	52	45
60.3	1	0	15
67.8	1	7	45
75.8	1	15	45
82.0	1	22	0
90.0	1	30	0

Aerodynamic Cut Size (u_{cyc})
187.9

PM_{10} Flow rate at actual cyclone conditions (Q_a)
0.0122

Actual D_{50}
10.5

Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 14-Mar-19 Client: OneSteel Hexham
AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

	Particulate Metals Results	Gaseous Metals Results	Oxidisable Mercury Results		
Metal	Front Half, Filter, Acetone Rinses and Acid Rinses (mg). **Containers 1, 2 and 3**	Back Half, Impingers + Acid Rinses (mg) **Container 4**	KO Impinger + Acid Rinses (mg) **(5A)**	$KMnO_4$/ H_2SO_4 + Rinses (mg) **(5B)**	Residue Rinse 8N HCl (mg) (If Required) **(5C)**
Antimony	0.00015	0.00015			
Arsenic	<0.00046	<0.0001			
Beryllium	<0.00005	<0.0001			
Cadmium	0.00037	<0.0002			
Chromium	0.0011	0.00049			
Cobalt	<0.0001	<0.0001			
Copper	0.0024	0.003			
Lead	0.0033	0.0013			
Magnesium	<0.29	0.029			
Manganese	0.0019	0.0011			
Mercury	0.00005	0.000048	<0.0001	0.00015	<0.0001
Nickel	0.00084	0.0005			
Selenium	0.00005	<0.0005			
Thallium	<0.0001	<0.0001			
Tin	0.008	0.0038			
Vanadium	<0.00299	<0.0039			
Zinc	<6.6	0.023			

Note: Where the blank has returned a less than value, half of this value was subtracted from the sample result as a blank correction
ie for a blank value of <0.0005, 0.00025 was subtracted from the sample result.

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

Stack Analysis - Hazardous Substances Elemental Analysis Results Continued

Date: 14-Mar-19 Client: OneSteel Hexham
AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m^3)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m^3)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m^3)	Total (mg)	Total (mg/m^3)	Mass Emission Rate (mg/s)
Antimony	0.00015	0.00016	0.00015	0.00016			0.0003	0.00031	0.0009
Arsenic	<0.00046	<0.00048	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Beryllium	<0.00005	<0.000052	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Cadmium	0.00037	0.00039	<0.0002	<0.00021			0.0004	0.00042	0.0012
Chromium	0.0011	0.0012	0.00049	0.00051			0.002	0.0021	0.0061
Cobalt	<0.0001	<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Copper	0.0024	0.0025	0.003	0.0031			0.005	0.0052	0.015
Lead	0.0033	0.0035	0.0013	0.0014			0.005	0.0052	0.015
Magnesium	<0.29	<0.3	0.029	0.03			0.03	0.031	0.09
Manganese	0.0019	0.002	0.0011	0.0012			0.003	0.0031	0.009
Mercury	0.00005	0.000052	0.000048	0.00005	0.00015	0.00016	0.0002	0.00021	0.00061
Nickel	0.00084	0.00088	0.0005	0.00052			0.001	0.001	0.0029
Selenium	0.00005	0.000052	<0.0005	<0.00052			0.00005	0.000052	0.00015
Thallium	<0.0001	<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.00029
Tin	0.008	0.0084	0.0038	0.004			0.01	0.01	0.029
Vanadium	<0.00299	<0.0031	<0.0039	<0.0041			<0.0001	<0.0001	<0.00029
Zinc	<6.6	<6.9	0.023	0.024			0.02	0.021	0.061
Total Hazardous Metals*	0.0078	0.0082	0.0036	0.0038	0.00015	0.00016	0.022	0.023	0.066
Total Metals	0.018	0.019	0.062	0.065			0.077	0.081	0.23

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

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Fine Particulate (PM10)

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

Date: 14-Mar-19 Client: OneSteel Hexham

AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.1496	m^3	Average barometric pressure (P_{BARO})	1014 hPa
Average gas meter temp. ($T_{M,2}$):	31.0	°C		
	304.2	K	Average pressure at meter ($P_{M,2}$)	1014.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.0332	m^3		

(B) PM10 concentration at standard conditions

Blank thimble No.: 0 Blank weight: g

Thimble No. used: M29 PM10 Weight 0.0028 g

Final PM10 Weight (Mp1): 0.00280 g

PM10 Concentration (C1): $=M_{p1}/MV_4=$ 0.0027 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 2.7 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0027 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 2.7 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.38 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 380 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: G024

V_v = 15.3 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0204

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

B_{ws} = 1.94 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Fine Particulate (PM10)

(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): 1.27 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 $\frac{(Ps)}{(1013.25)}$

= 1.132 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 7.31 m/s

(ii) Average of post-sampling velocities: 7.33 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 7.32 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 = 3.32 m^3/s (stack conditions)

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

Qstd = 2.9 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = C_{1a} x Qstd = 0.0078 g/s (0°C, dry gas, 1 atm pressure)
= 7.8 mg/s (0°C, dry gas, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

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

Date: 14-Mar-19 Client: OneSteel Hexham

AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.1272	m^3	Average barometric pressure (P_{BARO})	1014 hPa
Average gas meter temp. ($T_{M,2}$):	29.6	°C		
	302.8	K	Average pressure at meter ($P_{M,2}$)	1014.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.0178	m^3		

(B) Total Particulate concentration at standard conditions

Blank thimble No.: Blank weight: g

Thimble No. used: N23 Total Particulate Weight 0.0094 g

Final Total Particulate Weight (Mp1): 0.00940 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0092 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 9.2 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0092 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 9.2 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: O26

V_v = 8.3 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 ($V_{wsg(std)}$) = 0.0111

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

B_{ws} = 1.46 %

ANZ

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): 1.27 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 $\frac{(Ps)}{(1013.25)}$

= 1.132 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 7.31 m/s

(ii) Average of post-sampling velocities: 7.33 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 7.32 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 = 3.32 m^3/s (stack conditions)

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

Qstd = 2.9 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)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Hazardous Substances (Metals)

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

Date: 14-Mar-19 Client: OneSteel Hexham

AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.0566	m^3	Average barometric pressure (P_{BARO})	1014 hPa
Average gas meter temp. ($T_{M,2}$):	29.0	°C		
	302.2	K	Average pressure at meter ($P_{M,2}$)	1014.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	0.9559	m^3		

(B) Metals concentration at standard conditions

Blank thimble No.:			Blank weight:	g
Thimble No. used:	0		Metals Weight	0.000022 g
Final Metals Weight (Mp1):	0.00002	g		
Metals Concentration (C1):		$=M_{p1}/MV_4=$	0.000023	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.023	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.000023 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.023 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0032 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 3.2 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F21

V_v = 14.7 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 ($V_{wsg(std)}$) = 0.0196

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

B_{ws} = 2.28 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Hazardous Substances (Metals)

(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 $\frac{(Ps)}{(1013.25)}$

= 1.140 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 7.31 m/s

(ii) Average of post-sampling velocities: 7.33 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 7.32 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 = 3.32 m^3/s (stack conditions)

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

Qstd = 2.9 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = C_{1a} x Qstd = 0.000067 g/s (0°C, dry gas, 1 atm pressure)
= 0.067 mg/s (0°C, dry gas, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, SHREDDER STACK
ONESTEEL HEXHAM
14-Mar-19
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
HAZARDOUS SUBSTANCES (METALS)

Sampling Conditions:			
Stack internal diameter at test location	760 mm		
Stack gas temperature (average)	33.5 °C		306.7 K
Stack pressure (average)	1014 hPa		
Stack gas velocity (average, stack conditions)	7.3 m/s		
Stack gas flowrate (stack conditions)	3.3 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	2.9 m^3/s		
Fine Particulate (PM10) Testing			
Test Period	12:55	-	14:25
Fine Particulate (PM10) Mass	2.8 mg		
Gas Volume Sampled	1.03 m^3		
Fine Particulate (PM10) Emission*1	2.7 mg/m^3		
Fine Particulate (PM10) Mass Emission Rate*2	7.8 mg/s		
Regulatory Limit	N/A		
Total Particulate Testing			
Test Period	12:55	-	14:25
Total Particulate Mass	9.4 mg		
Gas Volume Sampled	1.02 m^3		
Total Particulate Emission*1	9.2 mg/m^3		
Total Particulate Mass Emission Rate*2	27 mg/s		
Regulatory Limit	100 mg/m^3		
Hazardous Substances (Metals) Testing			
Test Period	12:55	-	14:25
Hazardous Substances (Metals) Mass	0.022 mg		
Gas Volume Sampled	0.956 m^3		
Hazardous Substances (Metals) Emission*1	0.023 mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.067 mg/s		
Regulatory Limit	N/A		
Moisture Content (%)	1.9		
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 Results
(8 pages)

Appendix B Laboratory Results (8 pages)

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Colin Clarke	Manager	Adam Atkinson
Client	AECOM Australia Pty Ltd	Laboratory	SGS Melbourne EH&S
Address	17 Warabrook Boulevard Warabrook NSW 2304	Address	10/585 Blackburn Road Notting Hill Victoria 3168
Telephone	02 8295 3600	Telephone	+61395743200
Facsimile	02 8934 0001	Facsimile	+61395743399
Email	colin.clarke@aecom.com	Email	Au.SampleReceipt.Melbourne@sgs.com
Project	**60493017 / 3.1**	SGS Reference	**ME309936 R0**
Order Number	**60493017 / 3.1**	Date Received	19 Mar 2019
Samples	12	Date Reported	04 Apr 2019

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(14420).

SIGNATORIES

Adam Atkinson
Business Manager

Ryan Zhang
Team Leader

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	ME309936.001 Filter 14 Mar 2019 Metals No 1	ME309936.002 Filter 14 Mar 2019 Metals No 12	ME309936.003 Impinger 14 Mar 2019 Metals No 3	ME309936.004 Impinger 14 Mar 2019 Metals No 4
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 1/4/2019							
Sb	µg total	0.05		<0.05	<0.05	-	-
As	µg total	0.05		0.41	0.46	-	-
Be	µg total	0.05		<0.05	0.05	-	-
Cd	µg total	0.05		0.22	<0.05	-	-
Cr	µg total	0.05		2.0	1.7	-	-
Co	µg total	0.05		<0.05	<0.05	-	-
Cu	µg total	0.05		0.72	1.3	-	-
Pb	µg total	0.05		2.6	0.71	-	-
Mg	µg total	0.05		250	290	-	-
Mn	µg total	0.05		2.1	1.4	-	-
Hg	µg total	0.05		<0.05	<0.05	-	-
Ni	µg total	0.05		0.47	0.23	-	-
Se	µg total	0.05		0.15	0.10	-	-
Tl	µg total	0.05		<0.05	<0.05	-	-
Sn	µg total	0.05		0.17	0.15	-	-
V	µg total	0.25		0.62	0.69	-	-
Zn	µg total	0.05		5600	6600	-	-
Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 2/4/2019							
Sb	µg total	0.1		-	-	0.2	0.2
As	µg total	0.1		-	-	<0.1	<0.1
Be	µg total	0.1		-	-	<0.1	<0.1
Cd	µg total	0.1		-	-	0.2	0.2
Cr	µg total	0.1		-	-	0.6	0.8
Co	µg total	0.1		-	-	0.2	<0.1
Cu	µg total	0.1		-	-	3.9	3.2
Pb	µg total	0.1		-	-	53	1.4
Mg	µg total	0.1		-	-	27	29
Mn	µg total	0.1		-	-	5.6	1.6
Hg	µg total	0.1		-	-	<0.1	0.1
Ni	µg total	0.1		-	-	1.2	0.6
Se	µg total	0.1		-	-	<0.1	0.3
Tl	µg total	0.1		-	-	<0.1	<0.1
Sn	µg total	0.1		-	-	0.4	8.1
V	µg total	0.1		-	-	0.7	2.3
Zn	µg total	0.1		-	-	190	23
Sample Volume*	mL	-		-	-	85	310

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	ME309936.005 Impinger 14 Mar 2019 Metals No 8A	ME309936.006 Impinger 14 Mar 2019 Metals No 9	ME309936.007 Impinger 14 Mar 2019 Metals No 5A	ME309936.008 Impinger 14 Mar 2019 Metals No 5C
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 2/4/2019							
Sb	µg total	0.05		-	-	-	-
As	µg total	0.05		-	-	-	-
Be	µg total	0.05		-	-	-	-
Cd	µg total	0.05		-	-	-	-
Cr	µg total	0.05		-	-	-	-
Co	µg total	0.05		-	-	-	-
Cu	µg total	0.05		-	-	-	-
Pb	µg total	0.05		-	-	-	-
Mg	µg total	0.05		-	-	-	-
Mn	µg total	0.05		-	-	-	-
Hg	µg total	0.05		-	-	-	-
Ni	µg total	0.05		-	-	-	-
Se	µg total	0.05		-	-	-	-
Tl	µg total	0.05		-	-	-	-
Sn	µg total	0.05		-	-	-	-
V	µg total	0.25		-	-	-	-
Zn	µg total	0.05		-	-	-	-
Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 1/4/2019							
Sb	µg total	0.1		<0.1	<0.1	-	-
As	µg total	0.1		<0.1	<0.1	-	-
Be	µg total	0.1		<0.1	<0.1	-	-
Cd	µg total	0.1		<0.1	0.2	-	-
Cr	µg total	0.1		<0.1	0.3	-	-
Co	µg total	0.1		<0.1	<0.1	-	-
Cu	µg total	0.1		0.2	<0.1	-	-
Pb	µg total	0.1		<0.1	<0.1	-	-
Mg	µg total	0.1		<0.1	<0.1	-	-
Mn	µg total	0.1		0.4	0.1	-	-
Hg	µg total	0.1		<0.1	<0.1	<0.1	<0.1
Ni	µg total	0.1		<0.1	0.1	-	-
Se	µg total	0.1		0.3	0.2	-	-
Tl	µg total	0.1		<0.1	<0.1	-	-
Sn	µg total	0.1		0.1	4.1	-	-
V	µg total	0.1		2.3	1.6	-	-
Zn	µg total	0.1		<0.1	<0.1	-	-
Sample Volume*	mL	-		300	200	100	250

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	ME309936.009 Impinger 14 Mar 2019 Metals No 8B	ME309936.010 Impinger 14 Mar 2019 Metals No 11	ME309936.011 KMn04 14 Mar 2019 Metals No 5B	ME309936.012 KMn04 14 Mar 2019 Metals No 10
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 2/4/2019							
Sb	µg total	0.05		-	-	-	-
As	µg total	0.05		-	-	-	-
Be	µg total	0.05		-	-	-	-
Cd	µg total	0.05		-	-	-	-
Cr	µg total	0.05		-	-	-	-
Co	µg total	0.05		-	-	-	-
Cu	µg total	0.05		-	-	-	-
Pb	µg total	0.05		-	-	-	-
Mg	µg total	0.05		-	-	-	-
Mn	µg total	0.05		-	-	-	-
Hg	µg total	0.05		-	-	-	-
Ni	µg total	0.05		-	-	-	-
Se	µg total	0.05		-	-	-	-
Tl	µg total	0.05		-	-	-	-
Sn	µg total	0.05		-	-	-	-
V	µg total	0.25		-	-	-	-
Zn	µg total	0.05		-	-	-	-
Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 1/4/2019							
Sb	µg total	0.1		-	-	-	-
As	µg total	0.1		-	-	-	-
Be	µg total	0.1		-	-	-	-
Cd	µg total	0.1		-	-	-	-
Cr	µg total	0.1		-	-	-	-
Co	µg total	0.1		-	-	-	-
Cu	µg total	0.1		-	-	-	-
Pb	µg total	0.1		-	-	-	-
Mg	µg total	0.1		-	-	-	-
Mn	µg total	0.1		-	-	-	-
Hg	µg total	0.1		<0.1	<0.1	0.2	<0.1
Ni	µg total	0.1		-	-	-	-
Se	µg total	0.1		-	-	-	-
Tl	µg total	0.1		-	-	-	-
Sn	µg total	0.1		-	-	-	-
V	µg total	0.1		-	-	-	-
Zn	µg total	0.1		-	-	-	-
Sample Volume*	mL	-		200	250	390	99

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Sb	LB025742	µg total	0.05	<0.05	114%
As	LB025742	µg total	0.05	<0.05	106%
Be	LB025742	µg total	0.05	<0.05	93%
Cd	LB025742	µg total	0.05	<0.05	108%
Cr	LB025742	µg total	0.05	<0.05	105%
Co	LB025742	µg total	0.05	<0.05	110%
Cu	LB025742	µg total	0.05	<0.05	104%
Pb	LB025742	µg total	0.05	<0.05	112%
Mg	LB025742	µg total	0.05	<0.05	118%
Mn	LB025742	µg total	0.05	<0.05	108%
Hg	LB025742	µg total	0.05	<0.05	104%
Ni	LB025742	µg total	0.05	<0.05	104%
Se	LB025742	µg total	0.05	<0.05	99%
Tl	LB025742	µg total	0.05	<0.05	111%
Sn	LB025742	µg total	0.05	<0.05	106%
V	LB025742	µg total	0.25	<0.25	106%
Zn	LB025742	µg total	0.05	<0.05	107%

Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Sb	LB025743	µg total	0.1	<0.1	111%
As	LB025743	µg total	0.1	<0.1	103%
Be	LB025743	µg total	0.1	<0.1	94%
Cd	LB025743	µg total	0.1	<0.1	105%
Cr	LB025743	µg total	0.1	<0.1	103%
Co	LB025743	µg total	0.1	<0.1	109%
Cu	LB025743	µg total	0.1	<0.1	104%
Pb	LB025743	µg total	0.1	<0.1	108%
Mg	LB025743	µg total	0.1	<0.1	117%
Mn	LB025743	µg total	0.1	<0.1	106%
Hg	LB025743	µg total	0.1	<0.1	
Ni	LB025743	µg total	0.1	<0.1	103%
Se	LB025743	µg total	0.1	<0.1	95%
Tl	LB025743	µg total	0.1	<0.1	107%
Sn	LB025743	µg total	0.1	<0.1	104%
V	LB025743	µg total	0.1	<0.1	105%
Zn	LB025743	µg total	0.1	<0.1	105%
Sample Volume*	LB025743	mL	-	100	NA

METHOD	METHODOLOGY SUMMARY
EPA 29	Analysis of acid-leachable metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). This method is based on USEPA 3051A, USEPA M29, and USEPA 6020A. . Filters are digested using the appropriate sample preparation methods. A representative sample is extracted in concentrated acid using microwave heating by the CEM -MarsXPress (with Built-in USEPA method) Microwave Digestion system. The sample and acid are placed in a microwave vessel (TFM), which is then capped and heated in the microwave unit. After cooling, the vessel contents are diluted with DI water, then filtered/settled/centrifuged and analysed by ICP MS.
EPA29	This method covers the analysis of acid-leachable metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). This method is based on USEPA M29, USEPA 3015A and USEPA 6020A. Prior to analysis, samples are be solubilised or digested using the appropriate sample preparation methods.

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
QFL	QC result is below the lower tolerance
-	The sample was not analysed for this analyte
NVL	Not Validated

Unless it is reported that sampling has been perfomed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

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Steel River Testing

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

STACK EMISSION - PARTICULATES REPORT

Origin: AECOM - Newcastle
Project: **60493017**

Report : 18314-0-P

Description : Stack Emission Samples
Received: 15-Mar-19

Date : 21-Mar-19

Report To : Cye Buckland
17 Warabrook Blvd, Warabrook NSW 2304

Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
M29	Thimble	-	0.0028
N23	Thimble	-	0.0094

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

Note : Sampled by Client

Reported By: M. Campbell
Michael Campbell - Director

Determined in Accordance With:
Particulate matter - total in stack gases by gravimetric using in-house M300;
Acetone/Water Rinse using AS4323.2
Refer Form F422 - Measurement Uncertainty

Steel River Testing

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

STACK EMISSION - MOISTURE REPORT

Origin: AECOM - Newcastle
Project: **60493017**

Report : 18314-0-M

Description : Stack Emission Samples
Received: 15-Mar-19

Date : 21-Mar-19

Report To : Cye Buckland
17 Warabrook Blvd, Warabrook NSW 2304

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Jar ID	Moisture (g)
F21	14.7
G024	15.3
O26	8.3

Reported By: M. Campbell

Michael Campbell - Director

Determined in Accordance With:
Moisture content in stack gases by gravimetric using in-house M301
Refer Form F422 - Measurement Uncertainty

End of Report

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