PFAS burn trials report

Appendix 3: Stack testing report

SOURCE EMISSIONS MONITORING, INCLUDING PFAS – DRY CREEK INCINERATOR

VEOLIA AUSTRALIA NEW ZEALAND

Project ID. 11000

R_0

DATE OF RELEASE: 10/04/2019

Assured Environmental

ABN: 87 604 851 078

Unit 7, 142 Tennyson Memorial Avenue – Tennyson – Queensland – 4105

Table 1: Document approval

	Name	Position Title	Signature	Date
Author	Timon Berger	Technical Manager		09/04/2019
Reviewer	David Arbuckle	Manager		10/04/2019
Approver	David Arbuckle	Manager		10/04/2019

Table 2: Revision register

Revision	Date	Issuer	Recipient	Comment
R_0	10/04/2019	T. Berger	H. Macready	Formal report release
DRAFT_0	04/04/2019	T. Berger	H. Macready	Draft for comment

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ACCREDITED FOR COMPLIANCE TO ISO/IEC 17025 – TESTING

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Accreditation number: 19703

NATA
WORLD RECOGNISED ACCREDITATION
NATA ID: 19703

EXECUTIVE SUMMARY

Source emissions monitoring was conducted on the exhaust stack at the Veolia, Dry Creek Incinerator from the 26th to 28th February 2019 during specific trial conditions.

The parameters measured included the standard South Australian EPA permit parameters;

- Total solid particulates
- Carbon monoxide
- Oxides of nitrogen
- Fluorides (as HF)
- Heavy metals
- Dioxins and furans

In addition, samples were collected for Per- and poly-fluoroalkyl substances (PFAS) on each day of the trial.

Results are referenced to dry, 273°K and 101.3 kPa (STP) unless otherwise stated, with oxygen and carbon dioxide referencing for;

- Total solid particles (12% CO_2)
- Oxides of nitrogen – based on nitrogen dioxide (7% O_2)
- Dioxins and furans (11% O_2)

Where more than one measurement is performed for the same parameter per day, the result reported in the tables below is an average of the samples. Refer to the results section within this report for individual sample results (applies to particulates, NO_x and CO).

Table 3: Summary of results – Day 1

Incinerator Parameter		Result	Regulatory Limit	Unit	Reference		Emission Rate g/min
Total Solid Particles	<	4.1	70	mg/Nm³	STP & 12% CO_2	<	0.31
Carbon Monoxide	<	1.3	150	mg/Nm³	STP	<	0.36
Oxides of Nitrogen		213	500	mg/Nm³	STP & 7% O_2		23
Fluoride (total)	<	0.8	5	mg/Nm³	STP	<	0.20
Heavy Metals		0.0084	10	mg/Nm³	STP		0.0025
Mercury		0.0019	0.2	mg/Nm³	STP		0.000562
Lead		0.0062	5	mg/Nm³	STP		0.0018
PCDD/F (as TCDD I-TEQ) [d]		0.017	0.1	ng/Nm³	STP		5.0E-09
		0.031	0.1	ng/Nm³	STP & 11% O_2		-

Table Notes	
a	Heavy metals sum of Cd, Pb & Hg - lower bound
b	Oxides of nitrogen expressed as NO_2, average gas analyser result
c	Where multiple samples collected, the presented result is the average
d	Dioxins & Furans reported at lower bound
STP	results referenced to dry, 273K & 101.325 kPa

Table 4: Summary of results – PFAS day 1

Incinerator Parameter	Result ng/Nm^3	Blank Result ng/sample	Emission Rate g/min
PFAS			
10:2 Fluorotelomersulphonate	< 0.06	< 0.5	< 2.0E-08
4:2 Flurotelomersulphonate	< 0.06	< 0.5	< 2.0E-08
6:2 Fluorotelomersulphonate	< 0.06	< 0.5	< 2.0E-08
8:2 Fluorotelomersulphonate	< 0.06	< 0.5	< 2.0E-08
Perfluorooctane sulfonamide	< 0.06	< 0.5	< 2.0E-08
N-Ethyl-heptadecafluorooctane sulphonamide	< 0.06	< 0.5	< 2.0E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	< 0.06	< 0.5	< 2.0E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	< 0.13	< 1.0	< 3.9E-08
N-Methyl-heptadecafluorooctane sulphonamide	< 0.06	< 0.5	< 2.0E-08
N-Methylperfluorooctane sulphonamidoacetic acid	< 0.06	< 0.5	< 2.0E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	< 0.13	< 1.0	< 3.9E-08
Perfluorobutanoic acid	**1.3**	< 1.0	3.8E-07
Perfluorobutanesulfonic acid	< 0.06	< 0.5	< 2.0E-08
Perfluorodecanoic acid	< 0.06	< 0.5	< 2.0E-08
Perfluorododecanoic acid (PFDoA)	< 0.13	< 1.0	< 3.9E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	< 0.06	< 0.5	< 2.0E-08
Perfluorodecanesulfonic acid (PFDS)	< 0.06	< 0.5	< 2.0E-08
Perfluoroheptanoic acid (PFHpA)	< 0.06	< 0.5	< 2.0E-08
Perfluoroheptane sulfonate (PFHpS)	< 0.06	< 0.5	< 2.0E-08
Perfluorohexanoic acid (PFHxA)	< 0.06	< 0.5	< 2.0E-08
Perfluorohexane sulfonate (PFHxS)	< 0.06	< 0.5	< 2.0E-08
Perfluorononanoic acid (PFNA)	< 0.06	< 0.5	< 2.0E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	< 0.06	< 0.5	< 2.0E-08
Perfluorooctanoic acid (PFOA)	< 0.06	< 0.5	< 2.0E-08
Perfluorooctane sulfonate (PFOS)	< 0.06	< 0.5	< 2.0E-08
Perfluoropentanoic acid (PFPeA)	**1.7**	**2.7**	5.0E-07
Perfluoropentane sulfonic acid (PFPeS)	< 0.06	< 0.5	< 2.0E-08
Perfluorotetradecanoic acid (PFTeDA)	< 0.06	< 0.5	< 2.0E-08
Perfluorotridecanoic acid (PFTrDA)	< 0.06	< 0.5	< 2.0E-08
Perfluoroundecanoic acid (PFUnA)	< 0.06	< 0.5	< 2.0E-08
Breakthrough impinger analysis	ND		

Table 5: Summary of results – TOPA day 1

Incinerator Parameter		Result ng/Nm³		Blank Result ng/sample		Emission Rate g/min
TOP Assay						
10:2 Fluorotelomersulphonate	<	0.13	<	1.0	<	3.8E-08
4:2 Flurotelomersulphonate	<	0.13	<	1.0	<	3.8E-08
6:2 Fluorotelomersulphonate	<	0.13	<	1.0	<	3.8E-08
8:2 Fluorotelomersulphonate	<	0.13	<	1.0	<	3.8E-08
Perfluorooctane sulfonamide	<	0.13	<	1.0	<	3.8E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.13	<	1.0	<	3.8E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.13	<	1.0	<	3.8E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.27	<	2.0	<	7.6E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.13	<	1.0	<	3.8E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.13	<	1.0	<	3.8E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.27	<	2.0	<	7.6E-08
Perfluorobutanoic acid	<	0.13	<	2.0	<	3.8E-08
Perfluorobutanesulfonic acid		**0.16**	<	1.0		4.5E-08
Perfluorodecanoic acid	<	0.13	<	1.0	<	3.8E-08
Perfluorododecanoic acid (PFDoA)	<	0.27	<	2.0	<	7.6E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.13	<	1.0	<	3.8E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.13	<	1.0	<	3.8E-08
Perfluoroheptanoic acid (PFHpA)	<	0.13	<	1.0	<	3.8E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.13	<	1.0	<	3.8E-08
Perfluorohexanoic acid (PFHxA)	<	0.13	<	1.0	<	3.8E-08
Perfluorohexane sulfonate (PFHxS)	<	0.13	<	1.0	<	3.8E-08
Perfluorononanoic acid (PFNA)	<	0.13	<	1.0	<	3.8E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.13	<	1.0	<	3.8E-08
Perfluorooctanoic acid (PFOA)	<	0.13	<	1.0	<	3.8E-08
Perfluorooctane sulfonate (PFOS)	<	0.13	<	1.0	<	3.8E-08
Perfluoropentanoic acid (PFPeA)	**<**	**1.9**		**4.5**	<	5.2E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.13	<	1.0	<	3.8E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.13	<	1.0	<	3.8E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.13	<	1.0	<	3.8E-08
Perfluoroundecanoic acid (PFUnA)	<	0.13	<	1.0	<	3.8E-08
Breakthrough impinger analysis		ND				

Table 6: Summary of results – Day 2

Incinerator Parameter	Result	Regulatory Limit	Unit	Reference	Emission Rate g/min
Carbon Monoxide	2.3	150	mg/Nm^3	STP	0.6
Oxides of Nitrogen	194	500	mg/Nm^3	STP & 7% O_2	18
Fluoride (total)	< 1.0	5	mg/Nm^3	STP	< 0.27
Table Notes					
a	Where multiple samples collected, the presented result is the average				
b	Oxides of nitrogen expressed as NO_2, average gas analyser result				
STP	results referenced to dry, 273K & 101.325 kPa				

Table 7: Summary of results – PFAS day 2

Incinerator Parameter	Result ng/Nm^3	Blank Result ng/sample	Emission Rate g/min
PFAS			
10:2 Fluorotelomersulphonate	< 0.09	< 0.5	< 2.3E-08
4:2 Flurotelomersulphonate	< 0.09	< 0.5	< 2.3E-08
6:2 Fluorotelomersulphonate	< 0.09	< 0.5	< 2.3E-08
8:2 Fluorotelomersulphonate	< 0.09	< 0.5	< 2.3E-08
Perfluorooctane sulfonamide	< 0.09	< 0.5	< 2.3E-08
N-Ethyl-heptadecafluorooctane sulphonamide	< 0.09	< 0.5	< 2.3E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	< 0.09	< 0.5	< 2.3E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	< 0.18	< 1.0	< 4.7E-08
N-Methyl-heptadecafluorooctane sulphonamide	< 0.09	< 0.5	< 2.3E-08
N-Methylperfluorooctane sulphonamidoacetic acid	< 0.09	< 0.5	< 2.3E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	< 0.18	< 1.0	< 4.7E-08
Perfluorobutanoic acid	**2.0**	< 1.0	5.2E-07
Perfluorobutanesulfonic acid	< 0.09	< 0.5	< 2.3E-08
Perfluorodecanoic acid	< 0.09	< 0.5	< 2.3E-08
Perfluorododecanoic acid (PFDoA)	< 0.18	< 1.0	< 4.7E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	< 0.09	< 0.5	< 2.3E-08
Perfluorodecanesulfonic acid (PFDS)	< 0.09	< 0.5	< 2.3E-08
Perfluoroheptanoic acid (PFHpA)	< 0.09	< 0.5	< 2.3E-08
Perfluoroheptane sulfonate (PFHpS)	< 0.09	< 0.5	< 2.3E-08
Perfluorohexanoic acid (PFHxA)	< 0.09	< 0.5	< 2.3E-08
Perfluorohexane sulfonate (PFHxS)	< 0.09	< 0.5	< 2.3E-08
Perfluorononanoic acid (PFNA)	< 0.09	< 0.5	< 2.3E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	< 0.09	< 0.5	< 2.3E-08
Perfluorooctanoic acid (PFOA)	**46**[a]	< 0.5	1.2E-05
Perfluorooctane sulfonate (PFOS)	< 0.09	< 0.5	< 2.3E-08
Perfluoropentanoic acid (PFPeA)	**3.0**	**2.7**	7.8E-07
Perfluoropentane sulfonic acid (PFPeS)	< 0.09	< 0.5	< 2.3E-08
Perfluorotetradecanoic acid (PFTeDA)	< 0.09	< 0.5	< 2.3E-08
Perfluorotridecanoic acid (PFTrDA)	< 0.09	< 0.5	< 2.3E-08
Perfluoroundecanoic acid (PFUnA)	< 0.09	< 0.5	< 2.3E-08
Breakthrough impinger analysis	ND		

[a] Result identified as outlier, refer to Section 6 for detailed discussion.

Table 8: Summary of results – TOPA day 2

Incinerator Parameter	Result ng/Nm³	Blank Result ng/sample	Emission Rate g/min
TOP Assay			
10:2 Fluorotelomersulphonate	< 0.14	< 1.0	< 3.8E-08
4:2 Flurotelomersulphonate	< 0.14	< 1.0	< 3.8E-08
6:2 Fluorotelomersulphonate	< 0.14	< 1.0	< 3.8E-08
8:2 Fluorotelomersulphonate	< 0.14	< 1.0	< 3.8E-08
Perfluorooctane sulfonamide	< 0.14	< 1.0	< 3.8E-08
N-Ethyl-heptadecafluorooctane sulphonamide	< 0.14	< 1.0	< 3.8E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	< 0.14	< 1.0	< 3.8E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	< 0.28	< 2.0	< 7.6E-08
N-Methyl-heptadecafluorooctane sulphonamide	< 0.14	< 1.0	< 3.8E-08
N-Methylperfluorooctane sulphonamidoacetic acid	< 0.14	< 1.0	< 3.8E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	< 0.28	< 2.0	< 7.6E-08
Perfluorobutanoic acid	< 0.28	< 2.0	< 7.6E-08
Perfluorobutanesulfonic acid	**0.14**	< 1.0	3.8E-08
Perfluorodecanoic acid	< 0.14	< 1.0	< 3.8E-08
Perfluorododecanoic acid (PFDoA)	< 0.28	< 2.0	< 7.6E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	< 0.14	< 1.0	< 3.8E-08
Perfluorodecanesulfonic acid (PFDS)	< 0.14	< 1.0	< 3.8E-08
Perfluoroheptanoic acid (PFHpA)	< 0.14	< 1.0	< 3.8E-08
Perfluoroheptane sulfonate (PFHpS)	< 0.14	< 1.0	< 3.8E-08
Perfluorohexanoic acid (PFHxA)	< 0.14	< 1.0	< 3.8E-08
Perfluorohexane sulfonate (PFHxS)	< 0.14	< 1.0	< 3.8E-08
Perfluorononanoic acid (PFNA)	< 0.14	< 1.0	< 3.8E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	< 0.14	< 1.0	< 3.8E-08
Perfluorooctanoic acid (PFOA)	< 0.14	< 1.0	< 3.8E-08
Perfluorooctane sulfonate (PFOS)	< 0.14	< 1.0	< 3.8E-08
Perfluoropentanoic acid (PFPeA)	**< 1.2**	**4.5**	< 3.3E-07
Perfluoropentane sulfonic acid (PFPeS)	< 0.14	< 1.0	< 3.8E-08
Perfluorotetradecanoic acid (PFTeDA)	< 0.14	< 1.0	< 3.8E-08
Perfluorotridecanoic acid (PFTrDA)	< 0.14	< 1.0	< 3.8E-08
Perfluoroundecanoic acid (PFUnA)	< 0.14	< 1.0	< 3.8E-08
Breakthrough impinger analysis	ND		

Table 9: Summary of results – Day 3

Incinerator Parameter		Result	Regulatory Limit	Unit	Reference		Emission Rate g/min
Total Solid Particles		10	70	mg/Nm^3	STP & 12% CO_2		0.87
Carbon Monoxide	<	1.3	150	mg/Nm^3	STP	<	0.3
Oxides of Nitrogen		169	500	mg/Nm^3	STP & 7% O_2		17
Fluoride (total)	<	1.0	5	mg/Nm^3	STP	<	0.26
Heavy Metals		0.011	10	mg/Nm^3	STP		0.0028
Mercury		0.00021	0.2	mg/Nm^3	STP		0.000053
Lead		0.010	5	mg/Nm^3	STP		0.0027
PCDD/F (as TCDD I-TEQ) [d]		0.022	0.1	ng/Nm^3	STP		5.8E-09
		0.038	0.1	ng/Nm^3	STP & 11% O_2		-

Table Notes	
a	Heavy metals sum of Cd, Pb & Hg - lower bound
b	Oxides of nitrogen expressed as NO_2, average gas analyser result
c	Where multiple samples collected, the presented result is the average
d	Dioxins & Furans reported at lower bound
STP	results referenced to dry, 273K & 101.325 kPa

Table 10: Summary of results – PFAS day 3

Incinerator Parameter		Result ng/Nm³		Blank Result ng/sample		Emission Rate g/min
PFAS						
10:2 Fluorotelomersulphonate	<	0.07	<	0.5	<	2.0E-08
4:2 Flurotelomersulphonate	<	0.07	<	0.5	<	2.0E-08
6:2 Fluorotelomersulphonate	<	0.07	<	0.5	<	2.0E-08
8:2 Fluorotelomersulphonate	<	0.07	<	0.5	<	2.0E-08
Perfluorooctane sulfonamide	<	0.07	<	0.5	<	2.0E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.07	<	0.5	<	2.0E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.07	<	0.5	<	2.0E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.14	<	1.0	<	4.1E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.07	<	0.5	<	2.0E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.07	<	0.5	<	2.0E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.14	<	1.0	<	4.1E-08
Perfluorobutanoic acid		**2.7**	<	1.0		7.8E-07
Perfluorobutanesulfonic acid	<	0.07	<	0.5	<	2.0E-08
Perfluorodecanoic acid	<	0.07	<	0.5	<	2.0E-08
Perfluorododecanoic acid (PFDoA)	<	0.14	<	1.0	<	4.1E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.07	<	0.5	<	2.0E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.07	<	0.5	<	2.0E-08
Perfluoroheptanoic acid (PFHpA)	<	0.07	<	0.5	<	2.0E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.07	<	0.5	<	2.0E-08
Perfluorohexanoic acid (PFHxA)	<	0.07	<	0.5	<	2.0E-08
Perfluorohexane sulfonate (PFHxS)	<	0.07	<	0.5	<	2.0E-08
Perfluorononanoic acid (PFNA)	<	0.07	<	0.5	<	2.0E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.07	<	0.5	<	2.0E-08
Perfluorooctanoic acid (PFOA)		**0.11**	<	0.5		3.3E-08
Perfluorooctane sulfonate (PFOS)	<	0.07	<	0.5	<	2.0E-08
Perfluoropentanoic acid (PFPeA)		**3.2**		**2.7**		9.3E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.07	<	0.5	<	2.0E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.07	<	0.5	<	2.0E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.07	<	0.5	<	2.0E-08
Perfluoroundecanoic acid (PFUnA)	<	0.07	<	0.5	<	2.0E-08
Breakthrough impinger analysis		ND				

Table 11: Summary of results – TOPA day 3

Incinerator Parameter		Result ng/Nm³		Blank Result ng/sample		Emission Rate g/min
TOP Assay						
10:2 Fluorotelomersulphonate	<	0.16	<	1.0	<	4.4E-08
4:2 Flurotelomersulphonate	<	0.16	<	1.0	<	4.4E-08
6:2 Fluorotelomersulphonate	<	0.16	<	1.0	<	4.4E-08
8:2 Fluorotelomersulphonate	<	0.16	<	1.0	<	4.4E-08
Perfluorooctane sulfonamide	<	0.16	<	1.0	<	4.4E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.16	<	1.0	<	4.4E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.16	<	1.0	<	4.4E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.32	<	2.0	<	8.8E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.16	<	1.0	<	4.4E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.16	<	1.0	<	4.4E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.32	<	2.0	<	8.8E-08
Perfluorobutanoic acid	<	0.32	<	2.0	<	8.8E-08
Perfluorobutanesulfonic acid		**0.14**	<	1.0		3.8E-08
Perfluorodecanoic acid	<	0.16	<	1.0	<	4.4E-08
Perfluorododecanoic acid (PFDoA)	<	0.32	<	2.0	<	8.8E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.16	<	1.0	<	4.4E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.16	<	1.0	<	4.4E-08
Perfluoroheptanoic acid (PFHpA)	<	0.16	<	1.0	<	4.4E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.16	<	1.0	<	4.4E-08
Perfluorohexanoic acid (PFHxA)	<	0.16	<	1.0	<	4.4E-08
Perfluorohexane sulfonate (PFHxS)	<	0.16	<	1.0	<	4.4E-08
Perfluorononanoic acid (PFNA)	<	0.16	<	1.0	<	4.4E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.16	<	1.0	<	4.4E-08
Perfluorooctanoic acid (PFOA)	<	0.16	<	1.0	<	4.4E-08
Perfluorooctane sulfonate (PFOS)	<	0.16	<	1.0	<	4.4E-08
Perfluoropentanoic acid (PFPeA)	**<**	**1.4**		**4.5**	<	3.7E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.08	<	1.0	<	2.2E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.08	<	1.0	<	2.2E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.08	<	1.0	<	2.2E-08
Perfluoroundecanoic acid (PFUnA)	<	0.08	<	1.0	<	2.2E-08
Breakthrough impinger analysis		ND				

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1 INTRODUCTION

Assured Environmental (AE) was appointed by Veolia Environmental Services to sample and analyse source emissions from its incinerator in Dry Creek, South Australia. The sampling was conducted to coincide with trials of feeding contaminated material containing Per- and poly-fluoroalkyl substances (PFAS) into the incinerator over three days, between the 26th to 28th February 2019.

AE was responsible for the collection and analysis of all samples, unless otherwise indicated. The samples were recovered and stored in the appropriate manner until their return to the laboratory where the samples were prepared and analysed according to the appropriate methodology.

2 METHODOLGY & EQUIPMENT

2.1 Sampling methodology

All sampling and analysis were carried out in accordance to the listed requirements in Table 12. Any method specific comments about the sample and analysis procedures have been documented where required.

Table 12: Test methods

Parameter	Test Method	NATA	NOTES	ANALYSIS BY
Sample plane criteria	AS4323.1	Yes	A	1
Gas velocity & temperature	USEPA Method 2	Yes	nil	1
Oxygen & carbon dioxide	USEPA Method 3	Yes	nil	1
Moisture	USEPA Method 4	Yes	nil	1
Particulate matter	AS4323.2	Yes	nil	1
Oxides of nitrogen	USEPA Method 7E	Yes	nil	1
Carbon monoxide	USEPA Method 10	Yes	nil	1
Fluorides (total, as HF)	USEPA Method 13B	Yes	nil	1 & 2
Heavy metals	USEPA Method 29	Yes	nil	1 & 2
Dioxins & Furans	USEPA Method 23	Yes	nil	3
PFAS – speciation	USEPA SW846 Method 0010	No	B	4
PFAS TOP[b] Assay	USEPA SW846 Method 0010	No	C	4

Table 13: Analysis notes

Note	Company	Work performed	NATA ID	Report Number
1	AE Pty Ltd	Sampling & analysis	19703	11000
2	EnviroLab Services	Analysis	2901	212761
3	Assure Quality	Analysis	131 (IANZ accredited)	19-0053225-01440287
4	Leeder Analytical	Analysis	No[c]	L190056

[b] Total oxidisable precursor assay (TOP)

[c] While Leeder Analytics is NATA accredited for PFAS analyses in standard water and solid samples, the scope of accreditation doesn't cover air sampling media.

Table 14: Sample comments

Note	Comment
A	Sample location is compliant as per AS4323.1. The sample location is greater than two, but less than six diameters from a bend in the stack. The traverse point factor is 1.05, indicating a greater number of traverse points is sampled to account for the bend in the stack and any possible variation in differential pressure across the sample plane. See Table 19 for specific details.
B	A modified version of the USEPA SW846 Method 0010 sample train was employed to sample for PFAS material in the flue gas emission. Refer to section 2.2 for further information.
C	A modified version of the USEPA SW846 Method 0010 sample train was employed to sample for PFAS material with TOP Assay analysis. Refer to section 2.2 for further information.

Table 15: Heavy metals

Metals listed in permit	Abbreviation
Arsenic	As
Cadmium	Cd
Lead	Pb
Antimony	Sb
Mercury	Hg

Table 16: Dioxin & furan toxic equivalence factors

Substance	I-TEQ
	Toxic equivalence factor
2378 TCDF	0.1
2378 TCDD	1.0
12378 PeCDF	0.05
23478 PeCDF	0.5
12378 PeCDD	0.5
123478 HxCDF	0.1
123678 HxCDF	0.1
234678 HxCDF	0.1
123789 HxCDF	0.1
123478 HxCDD	0.1
123678 HxCDD	0.1
123789 HxCDD	0.1
1234678 HpCDF	0.01
1234789 HpCDF	0.01
1234678 HpCDD	0.01
OCDF	0.001
OCDD	0.001

2.2 Per- and poly-fluoroalkyl substances sample methodology

There are currently no promulgated reference methods for performing emissions monitoring for Per- and poly-fluoroalkyl substances (PFAS) from stationary emission sources. As such a procedure was employed using a reference method designed for similar compounds, in this case USEPA SW846 Method 0010 which was originally intended to sample isokinetically for semivolatile principal organic hazardous compounds, which may exist in either particulate or gaseous form. A summary of the sample train is;

- Gaseous and particulate pollutants are withdrawn from an emission source at an isokinetic sampling rate and are collected in a multi-component sampling train. The sample train contains a high-efficiency glass fibre filter and a packed bed of porous adsorbent resin. The filter is used to collect organic-laden particulate materials and the porous polymeric resin to adsorb semi-volatile organic species. Semi-volatile species are defined as compounds with boiling points greater than 100°C. The impingers downstream of the resin trap are loaded with water to knock-out any water vapour prior to metering the gas. These impingers are not routinely analysed for S-VOCs.

The modifications made to this sample train in order to target PFAS materials included;

- Sorbent material is XAD.
- The resin traps are spiked with surrogate PFAS standards as a QA step. A known quantity of standard is injected into the trap during preparation, the trap is then shipped, sampled and returned to the laboratory for analysis. The analysis includes detecting the injected standard, which provides a measure of the recovery efficiency. Factors that may affect the recovery efficiency include, sample transport and handling procedures, sampling temperatures (the resin must be chilled during sampling and maintained below 20°C) and sample preparation at the laboratory, including the extraction of the sample from the resin.
- The impingers downstream of the resin trap are loaded with a methanol solution and is intended to be a breakthrough detector. Following the sampling, the impinger contents are measured and placed in a sample bottle for shipment to the laboratory. The impinger fraction of the sample is then analysed separately to the filter, resin trap and front half methanol rinse to provide a measure of possible breakthrough. The intent of this sample train component is to provide a measure of breakthrough from the primary sampling components. Where no detections of PFAS material is made in this sample component, the limit of detection is not added to the sample result.
- Following the sampling onsite, all sample train components that have been in contact with the sample are rinsed thoroughly with methanol and stored in a sample container to be analysed as part of the sample.
- Sample train component material. According to documented water and soil PFAS sampling procedures, the use of glass, Teflon and stainless steel should be avoided and the use of polypropylene (PE) is recommended. PE is not considered to be conducive to source emissions sampling due to the temperatures of the flue gas. PE or HDPE cannot be used in the probe or filter box due to its low melting point, instead, all sampling components upstream of the resin trap was constructed of glass. Following sampling, all glassware was thoroughly rinsed with methanol at least three times to quantitatively recovery any possible PFAS material deposited on this surface.

- For the analysis, the samples are extracted using a solvent desorption technique, with the filter, front half methanol rinse and resin trap extract combined prior to analysis for the PFAS species. The analysis is performed using LC/MS/MS instruments, with each analysis performed using the surrogate spikes to determine sample specific recoveries.
- The total oxidisable precursor assay (TOP) sampling is performed using almost the same sample arrangement as the PFAS species analysis, with the exception that the sorbent trap is not loaded with the surrogate spike standards as this would interfere with the TOP Assay procedure, leading to false positive detections. The TOP Assay method is a standardised pre-treatment of sample extracts designed to expose underlying PFAS not amenable to standard analysis. The sample extracts are incubated with potassium persulfate and sodium hydroxide at 85°C for 6 hours. The samples are then neutralised and run for the full suite of PFAS compounds.

2.2.1 PFAS blank corrections

A handful of individual compounds were detected in the field blank samples. The following details the procedures used to correct for detections of PFAS species in the blank samples.

- Where the blank result is a non-detection, no adjustment to the sample result is made.
- Where the blank result returns a positive detection, but is less than half of the sample result, the blank value is subtracted from the sample result and reported as a positive detection.
- Where the blank value returns a positive detection, but is exceeding half of the sample result, no adjustments are made to the sample result, but it is reported as a less than value.

Table 17: List of PFAS / TOP species

Perfluorinated surfactants	Abbreviation
10:2 Fluorotelomersulphonate	10:2 FTS
4:2 Flurotelomersulphonate	4:2 FTS
6:2 Fluorotelomersulphonate	6:2 FTS
8:2 Fluorotelomersulphonate	8:2 FTS
Perfluorooctane sulfonamide	FOSA
N-Ethyl-heptadecafluorooctane sulphonamide	n-EtFOSA
N-Ethyl-perfluorooctane sulphonamidoacetic acid	N-EtFOSAA
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	n-EtFOSE
N-Methyl-heptadecafluorooctane sulphonamide	N-MeFOSA
N-Methylperfluorooctane sulphonamidoacetic acid	N-MeFOSAA
N-Methyl-heptadecafluorooctane sulphonamidoethanol	n-MeFOSE
Perfluorobutanoic acid	PFBA
Perfluorobutanesulfonic acid	PFBS
Perfluorodecanoic acid	PFDA
Perfluorododecanoic acid (PFDoA)	PFDoA
Perfluoro-1-dodecanesulphonic acid (PFDoS)	PFDoS
Perfluorodecanesulfonic acid (PFDS)	PFDS
Perfluoroheptanoic acid (PFHpA)	PFHpA
Perfluoroheptane sulfonate (PFHpS)	PFHpS
Perfluorohexanoic acid (PFHxA)	PFHxA
Perfluorohexane sulfonate (PFHxS)	PFHxS
Perfluorononanoic acid (PFNA)	PFNA
Perfluoro-1-nonanesulphonic acid (PFNS)	PFNS
Perfluorooctanoic acid (PFOA)	PFOA
Perfluorooctane sulfonate (PFOS)	PFOS
Perfluoropentanoic acid (PFPeA)	PFPeA
Perfluoropentane sulfonic acid (PFPeS)	PFPeS
Perfluorotetradecanoic acid (PFTeDA)	PFTeDA
Perfluorotridecanoic acid (PFTrDA)	PFTrDA
Perfluoroundecanoic acid (PFUnA)	PFUdA

2.3 Sample times

The sample collection was performed with close communications with the site operators to ensure that the process was stable and representative of the trial objectives during the sampling. The table below outlines the actual sample times for each sample, along with periods when the sampling was paused and the reasons for the stoppage.

Table 18: Test time summary

Sample	Date	Start time	End time	Test paused start time	Duration	Comment
	dd/mm/yyyy	hh:mm	hh:mm	hh:mm	minutes	
PM & PCDD/F	26/02/2019	7:46	11:26	-	-	
PM & Heavy metals	26/02/2019	12:15	13:35	-	-	
Fluoride	26/02/2019	14:32	15:55	-	-	
PFAS	26/02/2019	7:45	11:50	-	-	
TOP Assay	26/02/2019	13:10	17:15	-	-	
Fluoride	27/02/2019	16:50	18:13	-	-	
PFAS	27/02/2019	11:12	16:05	11:45	45	Suspected water injection issues
				14:50	10	Fan tripped, baghouse protection
TOP Assay	27/02/2019	11:15	16:10	11:45	45	Suspected water injection issues
				14:50	10	Fan tripped, baghouse protection
PM & PCDD/F	28/02/2019	8:03	11:41	8:15	10	Power trip to samplers
PM & Heavy metals	28/02/2019	14:10	15:32	-	-	
Fluoride	28/02/2019	12:05	13:28	-	-	
PFAS	28/02/2019	8:00	12:24	8:15	10	Power trip to samplers
TOP Assay	28/02/2019	13:40	17:45	16:45	10	Fan tripped, baghouse protection

2.4 Sample location

The stack sample point is located downstream of the bag-filters and the ID fan on a dedicated platform. The sample points are located approximately 5 diameters downstream from a bend, where the duct from the fan enters the stack at about 45°. The table below outlines the specific sample location details with reference to AS4323.1 requirements.

Table 19: Stack sample location summary

Sample location	Incinerator Stack
Stack Shape	CIRCULAR
Stack Diameter (m)	0.9
Stack Cross Section Area (m^2)	0.64
Distance to upstream disturbance (m)	4.6
Diameters (D)	5.1
Distance to downstream disturbance (m)	4.4
Diameters (D)	4.9
Total traverse point factors	1.05 , 1 , 1.05
Port size (mm)	90
Port Thread Type	BSP
Number of traverses	2
Number of points per traverse	8
Total number of traverse points	16
Flow & temperature compliance check (conditions a to f in AS4323.1)	YES

Figure 1: Sample platform

2.5 Test equipment

All equipment used during the testing meets all relevant performance standards as required by the sample methods. Our isokinetic equipment used for this project was from Apex Instruments[d]. Combustion gases were monitored using a Testo 350 flue gas analyser.

In order to complete all the required sampling within the timeline allowed for by the trial, two sample trains were run simultaneously.

Figure 2: Isokinetic sample train

Figure 3: Testo 350 Flue Gas Analyser

[d]http://www.apexinst.com/

Table 20: Testo Combustion Gas Analyser specifications

Compound	Range	Lower Detection Limit	Linearity
O_2	1 to 25 %	0.01%	+/- 1% selected range
SO_2	1 to 5000 ppm	1 ppm	+/- 2% selected range
CO	1 to 5,000 ppm	1 ppm	+/- 2% selected range
CO_2	0 to 50 %	0.01%	+/- 2% selected range
NO	1 to 1,000 ppm	1 ppm	+/- 2% selected range
NO_2	1 to 500 ppm	1 ppm	+/- 2% selected range
Lower Detection Limit	2X Noise at 60sec averaging		
Precision (% of point)	+/- 0.1%, measured with single gases at the span concentration		
Flow Rate	~ 0.5 liters per minute		
Accuracy	2% of span		
Span Drift	Less than 2% per week		
Zero Noise	0.5 ppm RMS (60sec averaging time)		
Response Time	60 seconds		

Table 21: Calibration records

Equipment	Equipment make	Equipment ID	Last calibration date	Calibration information
Isokinetic sample console 1	APEX XC572	SN173	11.01.2019	Y = 0.973 ΔH@ = 47.761
Liquid incline manometer	APEX XC572	SN173	11.01.2019	Correction factor = 1
Isokinetic sample console 2	APEX XC572	SN368	15.01.2019	Y = 1.052 ΔH@ = 48.138
Liquid incline manometer	APEX XC572	SN368	15.01.2019	Correction factor = 1
S-type pitot end	APEX	PN08	10.05.2017	Dimension check as per USEPA M2. Daily Visual inspection OK
Combustion gas analyser	Testo	SN665	22 Feb & 4 Mar	Pre and post project calibration

3 QUALITY ASSURANCE & QUALITY CONTROL (QA/QC)

AE operates within a quality system based upon the requirements of ISO17025. Our quality system defines specific procedures and methodologies to ensure any project undertaken by AE is conducted with the highest level of quality given the specific confines of each project. The overall objective of our QA/QC procedures is to representatively sample and accurately analyse components in the gas streams and therefore report valid measurements of emission concentrations.

To ensure representativeness of field work, our quality procedures target:

1. Correct sampling locations
2. Sample time
3. Frequency of samples and
4. Method selection & adherence

To ensure representativeness of lab work, our quality procedures target:

1. Sample preservation
2. Chain of custody (COC)
3. Sample preparation and
4. Analytical techniques

AE maintains strict quality assurance throughout all its sampling programs, covering on-site 'field work' and the analytical phase of our projects. Our QA program covers the calibration of all sampling and analytical apparatus where applicable and the use of spikes, replicate sample and reference standards. The test methodologies used for this project are outlined in the method section of this document. Field test data has been recorded and calculated using direct entry into Microsoft Excel spreadsheets following the procedures of the appropriate test methods. Determination of emission concentrations has been performed using the same Microsoft Excel spreadsheets which are partially supplied as an attachment to this report. More detailed information can be supplied upon request.

QA/QC checks for this project will use validation techniques and criteria appropriate to the type of data and the purpose of the measurement to approve the test report. Records of all data will be maintained. Complete chain of custody (COC) procedures have been followed to document the entire custodial history of each sample. The COC forms also served as a laboratory sheet detailing sample ID and analysis requirements.

Table 22: Sampling data QA/QC checklist

Sampling Data QA/QC Checklist	Comment
Use of appropriate test methods	Yes
Operation of the process being tested	Yes – as instructed by client
Use of properly operating and calibrated test equipment	Yes
Use of high purity reagents	Yes
Performance of leak checks post sample (at least)	Yes

Table 23: Laboratory data QA/QC checklist

Laboratory Data QA/QC Checklist	Comment
Use of appropriate analytical methods	Yes
Use of properly operating and calibrated analytical equipment	Yes
Precision and accuracy comparable to that achieved in similar projects	Yes
Accurate reporting	Yes

3.1 Measurement uncertainty

There is an inherent uncertainty associated with any scientific measurement, including stack emissions monitoring. The measurement uncertainty can be controlled with strict adherence to the reference methodology along with utilising appropriate calibration standards with corresponding acceptable uncertainty reports. Many source sampling methods do not outline exact procedures for establishing direct measurement uncertainty. In the absence of a defined procedure, the uncertainty budgets presented are based on estimations using ISO-GUM method.

Each individual source and test may have a unique associated uncertainty assigned, due to factors such as the stack sample location in relation to the positioning requirements of AS4323.1, stack temperature, water vapour content and sample analysis. The table below outlines the estimated uncertainties associate with reports presented within this report.

Table 24: Sample uncertainty

Parameter	Reference method	Uncertainty ± %	Coverage factor	Confidence coefficient %
Velocity	USEPA Method 2	6.6	2	95
Temperature	USEPA Method 2	3.0	2	95
Moisture content	USEPA Method 4	5.0	2	95
Oxygen	USEPA Method 3A	6.0	2	95
Particulate matter	AS 4323.2	20	2	95
Sulfur dioxide	USEPA Method 6C	12	2	95
Oxides of nitrogen	USEPA Method 7E	9.0	2	95
Heavy metals	USEPA Method 29	16	2	95
Hydrogen chloride	USEPA Method 26	15	2	95
Total fluoride	USEPA Method 13B	15	2	95
Dioxins & furans	USEPA Method 23	20	2	95
PFAS[e]	USEPA SW846 Method 0010	30	2	95
TOP Assay[b]	USEPA SW846 Method 0010	30	2	95

The recoveries of surrogate standards from the sampling and analysis are presented in the table below. The expected QC recovery for measurements in the ppb to ppt levels is in the range of 60 to 120%. The results are not corrected for the recovery.

Table 25: PFAS & TOPA surrogate recovery (%)

Surrogate	Sample 1	Sample blank	Sample 6	Sample 11	Lab blank
	PFAS	PFAS	PFAS	PFAS	PFAS
M2-PFOA	84	97	84	100	100
M-PFOS	92	94	81	102	102
M-PFDA	76	87	80	100	100
Sampling (118-79-6)	59	57	63	66	66
Surrogate	**Sample 2**	**Sample blank**	**Sample 7**	**Sample 12**	**Lab blank**
	TOPA	TOPA	TOPA	TOPA	TOPA
M2-PFOA	92	103	91	90	89
M-PFOS	91	96	81	90	87
M-PFDA	96	109	93	98	90
Sampling (118-79-6)	Field sampling spike not possible				

[e] Because the sampling method is not a promulgated test method, the uncertainty provided is an estimation based on assumptions.

4 DEFINITIONS

The following terms and abbreviations may be used in this report:

Table 26: Definitions

Symbol	Definition
<	The analytes tested for was not detected; the value stated is the reportable limit of detection
Am^3	Gas volume in cubic metres at measured conditions
AS	Australian Standard
BH	Back half of sample train (filter holder and impingers) (referred to during sample recovery)
°C	Degrees Celsius
CARB	California Air Resources Board methods
dscm	dry standard cubic meters
FH	Front half of sample train (probe and filter holder) (referred to during sample recovery)
f/ml	Fibres per millilitre
g	Grams
kg	Kilograms
m	Metres
m^3	actual gas volume in cubic metres as measured
mbar	Millibars
mg	Milligrams (10^{-3} grams)
min	Minute
ml	Millilitres
mmH_2O	Millimetres of water
Mole	SI unit that measures the amount of substance
N/A	Not applicable
ng	Nanograms (10^{-9} grams)
NATO	North Atlantic Treaty Organisation
ND	Not detected
NIOSH	National institute for occupational safety and health (USA)
Nm^3	Gas volume in dry cubic metres at standard temperature and pressure (0°C and 101.3 kPa)
NMI	National Measurement Institute
NM VOC	Non methane volatile organic compound
NR	Not required on this occasion
OSHA	Occupational Safety and Health Act
ou	Odour unit
PCDD	Polychlorinated dibenzo-*p*-dioxin
PCDF	Polychlorinated dibenzofuran
PFAS	Per- and poly-fluoroalkyl substances
PM	Particulate matter
ppb	Parts per billion
ppm	Parts per million
sec	Second
Sm^3	Gas volume in dry cubic metres at standard temperature and pressure (0°C and 101.3 kPa) and corrected to a standardised value (e.g. 15% O_2)
STP	Standard temperature and pressure (0°C and 101.3 kPa)
TO	USEPA air toxics method
TOPA	Total oxidisable precursor assay
TWA	Time weighted average
USEPA	United States Environmental Protection Authority

5 RESULTS

5.1 Trial Day 1 – solid waste

Table 27: Day 1 – PFAS

Site		Adelaide				
Sample Location		Incinerator stack				
Reference Method		USEPAM0010 - ISOKINETIC				
Run ID		1				
Test Parameter		PFAS				
Test Date	dd/mm/yyyy	26/02/2019				
Start Time	hh:mm	7:45:00				
End Time	hh:mm	11:50:00				
Average Stack Temperature	°C	189				
Absolute Stack Pressure	mb	1019				
Moisture Content	% v/v	8.1				
Dry Gas Density	kg/Nm^3	1.30				
Dry Gas Molecular Weight	g/g-mole	29.1				
Sample Volume (dry gas meter)	Nm^3	3.86				
Stack Gas Velocity	m/sec	17.2				
Actual Stack Flow Rate	m^3/min	551				
Dry Standard Stack Flow Rate	Nm^3/min	301				
Percent Isokinetic Rate	%	98				
Pollutant		Concentration				Emission Rate
		stack conditions		standard conditions		standard conditions
PFAS species		ng/m^3		ng/Nm^3		g/min
10:2 Fluorotelomersulphonate	<	0.04	<	0.06	<	1.95E-08
4:2 Flurotelomersulphonate	<	0.04	<	0.06	<	1.95E-08
6:2 Fluorotelomersulphonate	<	0.04	<	0.06	<	1.95E-08
8:2 Fluorotelomersulphonate	<	0.04	<	0.06	<	1.95E-08
Perfluorooctane sulfonamide	<	0.04	<	0.06	<	1.95E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.04	<	0.06	<	1.95E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.04	<	0.06	<	1.95E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.07	<	0.13	<	3.90E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.04	<	0.06	<	1.95E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.04	<	0.06	<	1.95E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.07	<	0.13	<	3.90E-08
Perfluorobutanoic acid		0.69		1.27		3.82E-07
Perfluorobutanesulfonic acid	<	0.04	<	0.06	<	1.95E-08
Perfluorodecanoic acid	<	0.04	<	0.06	<	1.95E-08
Perfluorododecanoic acid (PFDoA)	<	0.07	<	0.13	<	3.90E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.04	<	0.06	<	1.95E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.04	<	0.06	<	1.95E-08
Perfluoroheptanoic acid (PFHpA)	<	0.04	<	0.06	<	1.95E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.04	<	0.06	<	1.95E-08
Perfluorohexanoic acid (PFHxA)	<	0.04	<	0.06	<	1.95E-08
Perfluorohexane sulfonate (PFHxS)	<	0.04	<	0.06	<	1.95E-08
Perfluorononanoic acid (PFNA)	<	0.04	<	0.06	<	1.95E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.04	<	0.06	<	1.95E-08
Perfluorooctanoic acid (PFOA)	<	0.04	<	0.06	<	1.95E-08
Perfluorooctane sulfonate (PFOS)	<	0.04	<	0.06	<	1.95E-08
Perfluoropentanoic acid (PFPeA)		0.91		1.66		4.99E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.04	<	0.06	<	1.95E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.04	<	0.06	<	1.95E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.04	<	0.06	<	1.95E-08
Perfluoroundecanoic acid (PFUnA)	<	0.04	<	0.06	<	1.95E-08

Table 28: Day 1 – TOPA

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPAM0010 - ISOKINETIC
Run ID		2
Test Parameter		TOP Assay
Test Date	dd/mm/yyyy	26/02/2019
Start Time	hh:mm	13:10:00
End Time	hh:mm	17:15:00
Average Stack Temperature	°C	194
Absolute Stack Pressure	mb	1019
Moisture Content	% v/v	7.8
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.1
Sample Volume (dry gas meter)	Nm^3	3.73
Stack Gas Velocity	m/sec	16.2
Actual Stack Flow Rate	m^3/min	521
Dry Standard Stack Flow Rate	Nm^3/min	282
Percent Isokinetic Rate	%	101

Pollutant	Concentration				Emission Rate	
	stack conditions		standard conditions		standard conditions	
TOP Assay	ng/m^3		ng/Nm^3		g/min	
10:2 Fluorotelomersulphonate	<	0.07	<	0.13	<	3.79E-08
4:2 Flurotelomersulphonate	<	0.07	<	0.13	<	3.79E-08
6:2 Fluorotelomersulphonate	<	0.07	<	0.13	<	3.79E-08
8:2 Fluorotelomersulphonate	<	0.07	<	0.13	<	3.79E-08
Perfluorooctane sulfonamide	<	0.07	<	0.13	<	3.79E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.07	<	0.13	<	3.79E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.07	<	0.13	<	3.79E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.15	<	0.27	<	7.57E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.07	<	0.13	<	3.79E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.07	<	0.13	<	3.79E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.15	<	0.27	<	7.57E-08
Perfluorobutanoic acid	<	0.07	<	0.13	<	3.79E-08
Perfluorobutanesulfonic acid		0.09		0.16		4.54E-08
Perfluorodecanoic acid	<	0.07	<	0.13	<	3.79E-08
Perfluorododecanoic acid (PFDoA)	<	0.15	<	0.27	<	7.57E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.07	<	0.13	<	3.79E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.07	<	0.13	<	3.79E-08
Perfluoroheptanoic acid (PFHpA)	<	0.07	<	0.13	<	3.79E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.07	<	0.13	<	3.79E-08
Perfluorohexanoic acid (PFHxA)	<	0.07	<	0.13	<	3.79E-08
Perfluorohexane sulfonate (PFHxS)	<	0.07	<	0.13	<	3.79E-08
Perfluorononanoic acid (PFNA)	<	0.07	<	0.13	<	3.79E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.07	<	0.13	<	3.79E-08
Perfluorooctanoic acid (PFOA)	<	0.07	<	0.13	<	3.79E-08
Perfluorooctane sulfonate (PFOS)	<	0.07	<	0.13	<	3.79E-08
Perfluoropentanoic acid (PFPeA)	<	1.00	<	1.85	<	5.23E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.07	<	0.13	<	3.79E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.07	<	0.13	<	3.79E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.07	<	0.13	<	3.79E-08
Perfluoroundecanoic acid (PFUnA)	<	0.07	<	0.13	<	3.79E-08

Table 29: Day 1 – Dioxins/furans

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPA M23 - ISOKINETIC
Run ID		3
Test Parameter		PM & PCDD/F
Test Date	dd/mm/yyyy	26/02/2019
Start Time	hh:mm	7:46:00
End Time	hh:mm	11:26:00

Average Stack Temperature	°C	190
Absolute Stack Pressure	mb	1019
Moisture Content	% v/v	8.0
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.1
Sample Volume (dry gas meter)	Nm^3	2.67
Stack Gas Velocity	m/sec	17.3
Actual Stack Flow Rate	m^3/min	554
Dry Standard Stack Flow Rate	Nm^3/min	302
Percent Isokinetic Rate	%	100

Pollutant	Concentration stack conditions	Concentration standard conditions	Emission Rate standard conditions	Concentration 12% CO_2
Particulate Matter (PM) Concentration	mg/m^3	mg/Nm^3	g/min	mg/Nm^3
Stack PM Concentration	< 0.41	< 0.75	< 0.23	< 2.9

Dioxin and Furan (USEPA Method 23)	stack conditions ng/m^3	standard conditions ng/Nm^3	standard conditions g/min	11% O_2 ng/Nm^3
2378 TCDF	0.002658	0.00487	1.47E-09	0.00918
Total TCDF isomers	0.01666	0.03054	9.22E-09	0.0575
2378 TCDD	< 0.001200	< 0.00220	< 6.64E-10	< 0.0041
Total TCDD isomers	0.0981	0.1799	5.43E-08	0.3389
12378 PeCDF	0.002495	0.00457	1.38E-09	0.0086
23478 PeCDF	0.00366	0.00671	2.03E-09	0.0126
Total PeCDF isomers	0.02883	0.05284	1.60E-08	0.0996
12378 PeCDD	< 0.003210	< 0.00588	< 1.78E-09	< 0.0111
Total PeCDD isomers	0.0869	0.1593	4.81E-08	0.3001
123478 HxCDF	0.00485	0.00888	2.68E-09	0.0167
123678 HxCDF	0.00389	0.00712	2.15E-09	0.0134
234678 HxCDF	0.048665	0.08919	2.69E-08	0.1680
123789 HxCDF	< 0.002208	< 0.004047	< 1.22E-09	< 0.0076
Total HxCDF isomers	0.02924	0.0536	1.62E-08	0.1010
123478 HxCDD	< 0.00233	< 0.00427	< 1.29E-09	< 0.0080
123678 HxCDD	0.00675	0.01237	3.73E-09	0.0233
123789 HxCDD	< 0.00742	< 0.01360	< 4.11E-09	< 0.0256
Total HxCDD isomers	0.0879	0.1611	4.87E-08	0.3036
1234678 HpCDF	0.01043	0.01911	5.77E-09	0.0360
1234789 HpCDF	0.002781	0.005096	1.54E-09	0.0096
Total HpCDF isomers	0.01936	0.03549	1.07E-08	0.0669
1234678 HpCDD	0.02208	0.04047	1.22E-08	0.0763
Total HpCDD isomers	0.04539	0.08319	2.51E-08	0.1567
OCDF	0.00491	0.00899	2.72E-09	0.0169
OCDD	0.02515	0.04609	1.39E-08	0.0868
Sum of congeners				
Lower	0.4425	0.811	2.45E-07	1.528
Medium	0.4425	0.811	2.45E-07	1.528
Upper	0.4425	0.811	2.45E-07	1.528
Total I-TEQ				
Lower	0.00902	0.01653	4.99E-09	0.03114
Medium	0.01102	0.02019	6.10E-09	0.03805
Upper	0.01302	0.02386	7.21E-09	0.04496

Table 30: Day 1 – Heavy metals

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPA M29 - ISOKINETIC
Run ID		5
Test Parameter		PM & Heavy metals
Test Date	dd/mm/yyyy	26/02/2019
Start Time	hh:mm	12:15:00
End Time	hh:mm	13:35:00
Average Stack Temperature	°C	195
Absolute Stack Pressure	mb	1019
Moisture Content	% v/v	8.3
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.1
Sample Volume (dry gas meter)	Nm^3	1.45
Stack Gas Velocity	m/sec	16.9
Actual Stack Flow Rate	m^3/min	543
Dry Standard Stack Flow Rate	Nm^3/min	292
Percent Isokinetic Rate	%	101

Pollutant	Concentration stack conditions	Concentration standard conditions	Emission Rate standard conditions	Concentration 12% CO_2
Particulate Matter (PM) Concentration	mg/m^3	mg/Nm^3	g/min	mg/Nm^3
Stack PM Concentration	< 0.74	< 1.38	0.40	5.3

Heavy Metals (USEPA Method 29)	stack conditions µg/m^3	standard conditions µg/Nm^3	standard conditions g/min
Arsenic	< 2.10	< 3.90	< 0.00114
Cadmium	0.15	0.28	0.00008
Lead	3.34	6.21	0.00181
Antimony	< 2.10	< 3.90	< 0.00114
Mercury	1.035	1.924	0.0005625
Total Heavy Metals (lower bound)	4.5	8.4	0.00246

Table 31: Day 1 – Fluorides

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPA M13b - ISOKINETIC
Run ID		4
Test Parameter		Fluoride
Test Date	dd/mm/yyyy	26/02/2019
Start Time	hh:mm	14:32:00
End Time	hh:mm	15:55:00
Average Stack Temperature	°C	196
Absolute Stack Pressure	mb	1019
Moisture Content	% v/v	7.9
Dry Gas Density	kg/Nm^3	1.3
Dry Gas Molecular Weight	g/g-mole	29.1
Sample Volume (dry gas meter)	Nm^3	1.33
Stack Gas Velocity	m/sec	15.7
Actual Stack Flow Rate	m^3/min	505
Dry Standard Stack Flow Rate	Nm^3/min	272
Percent Isokinetic Rate	%	100

Pollutant	Concentration stack conditions	standard conditions	Emission Rate standard conditions
Total Fluorides	mg/m^3	mg/Nm^3	g/min
Total fluoride (as HF)	< 0.405	< 0.751	< 0.204

5.2 Trial day 2 – liquid waste

Table 32: Day 2 – PFAS

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPAM0010 - ISOKINETIC
Run ID		6
Test Parameter		PFAS
Test Date	dd/mm/yyyy	27/02/2019
Start Time	hh:mm	11:12:00
End Time	hh:mm	16:05:00
Average Stack Temperature	°C	196
Absolute Stack Pressure	mb	1017
Moisture Content	% v/v	8.7
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	2.76
Stack Gas Velocity	m/sec	15.1
Actual Stack Flow Rate	m^3/min	484
Dry Standard Stack Flow Rate	Nm^3/min	259
Percent Isokinetic Rate	%	96

Pollutant	Concentration		Emission Rate
	stack conditions	standard conditions	standard conditions
PFAS species	ng/m^3	ng/Nm^3	g/min
10:2 Fluorotelomersulphonate	< 0.05	< 0.09	< 2.35E-08
4:2 Flurotelomersulphonate	< 0.05	< 0.09	< 2.35E-08
6:2 Fluorotelomersulphonate	< 0.05	< 0.09	< 2.35E-08
8:2 Fluorotelomersulphonate	< 0.05	< 0.09	< 2.35E-08
Perfluorooctane sulfonamide	< 0.05	< 0.09	< 2.35E-08
N-Ethyl-heptadecafluorooctane sulphonamide	< 0.05	< 0.09	< 2.35E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	< 0.05	< 0.09	< 2.35E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	< 0.10	< 0.18	< 4.69E-08
N-Methyl-heptadecafluorooctane sulphonamide	< 0.05	< 0.09	< 2.35E-08
N-Methylperfluorooctane sulphonamidoacetic acid	< 0.05	< 0.09	< 2.35E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	< 0.10	< 0.18	< 4.69E-08
Perfluorobutanoic acid	1.07	2.00	5.16E-07
Perfluorobutanesulfonic acid	< 0.05	< 0.09	< 2.35E-08
Perfluorodecanoic acid	< 0.05	< 0.09	< 2.35E-08
Perfluorododecanoic acid (PFDoA)	< 0.10	< 0.18	< 4.69E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	< 0.05	< 0.09	< 2.35E-08
Perfluorodecanesulfonic acid (PFDS)	< 0.05	< 0.09	< 2.35E-08
Perfluoroheptanoic acid (PFHpA)	< 0.05	< 0.09	< 2.35E-08
Perfluoroheptane sulfonate (PFHpS)	< 0.05	< 0.09	< 2.35E-08
Perfluorohexanoic acid (PFHxA)	< 0.05	< 0.09	< 2.35E-08
Perfluorohexane sulfonate (PFHxS)	< 0.05	< 0.09	< 2.35E-08
Perfluorononanoic acid (PFNA)	< 0.05	< 0.09	< 2.35E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	< 0.05	< 0.09	< 2.35E-08
Perfluorooctanoic acid (PFOA)	24.8	46.5	1.20E-05
Perfluorooctane sulfonate (PFOS)	< 0.05	< 0.09	< 2.35E-08
Perfluoropentanoic acid (PFPeA)	1.61	3.01	7.79E-07
Perfluoropentane sulfonic acid (PFPeS)	< 0.05	< 0.09	< 2.35E-08
Perfluorotetradecanoic acid (PFTeDA)	< 0.05	< 0.09	< 2.35E-08
Perfluorotridecanoic acid (PFTrDA)	< 0.05	< 0.09	< 2.35E-08
Perfluoroundecanoic acid (PFUnA)	< 0.05	< 0.09	< 2.35E-08

Table 33: Day 2 – TOPA

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPAM0010 - ISOKINETIC
Run ID		7
Test Parameter		TOP Assay
Test Date	dd/mm/yyyy	27/02/2019
Start Time	hh:mm	11:15:00
End Time	hh:mm	16:10:00
Average Stack Temperature	°C	194
Absolute Stack Pressure	mb	1017
Moisture Content	% v/v	8.6
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	3.54
Stack Gas Velocity	m/sec	15.6
Actual Stack Flow Rate	m^3/min	500
Dry Standard Stack Flow Rate	Nm^3/min	268
Percent Isokinetic Rate	%	101

Pollutant	Concentration stack conditions		Concentration standard conditions		Emission Rate standard conditions	
TOP Assay		ng/m^3		ng/Nm^3		g/min
10:2 Fluorotelomersulphonate	<	0.08	<	0.14	<	3.79E-08
4:2 Flurotelomersulphonate	<	0.08	<	0.14	<	3.79E-08
6:2 Fluorotelomersulphonate	<	0.08	<	0.14	<	3.79E-08
8:2 Fluorotelomersulphonate	<	0.08	<	0.14	<	3.79E-08
Perfluorooctane sulfonamide	<	0.08	<	0.14	<	3.79E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.08	<	0.14	<	3.79E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.08	<	0.14	<	3.79E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.15	<	0.28	<	7.58E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.08	<	0.14	<	3.79E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.08	<	0.14	<	3.79E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.15	<	0.28	<	7.58E-08
Perfluorobutanoic acid	<	0.15	<	0.28	<	7.58E-08
Perfluorobutanesulfonic acid		0.08		0.14		3.79E-08
Perfluorodecanoic acid	<	0.08	<	0.14	<	3.79E-08
Perfluorododecanoic acid (PFDoA)	<	0.15	<	0.28	<	7.58E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.08	<	0.14	<	3.79E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.08	<	0.14	<	3.79E-08
Perfluoroheptanoic acid (PFHpA)	<	0.08	<	0.14	<	3.79E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.08	<	0.14	<	3.79E-08
Perfluorohexanoic acid (PFHxA)	<	0.08	<	0.14	<	3.79E-08
Perfluorohexane sulfonate (PFHxS)	<	0.08	<	0.14	<	3.79E-08
Perfluorononanoic acid (PFNA)	<	0.08	<	0.14	<	3.79E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.08	<	0.14	<	3.79E-08
Perfluorooctanoic acid (PFOA)	<	0.08	<	0.14	<	3.79E-08
Perfluorooctane sulfonate (PFOS)	<	0.08	<	0.14	<	3.79E-08
Perfluoropentanoic acid (PFPeA)	<	0.65	<	1.21	<	3.26E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.08	<	0.14	<	3.79E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.08	<	0.14	<	3.79E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.08	<	0.14	<	3.79E-08
Perfluoroundecanoic acid (PFUnA)	<	0.08	<	0.14	<	3.79E-08

Table 34: Day 2 – Fluorides

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPA M13b - ISOKINETIC
Run ID		9
Test Parameter		Fluoride
Test Date	dd/mm/yyyy	27/02/2019
Start Time	hh:mm	16:50
End Time	hh:mm	18:13
Average Stack Temperature	°C	197
Absolute Stack Pressure	mb	1016
Moisture Content	% v/v	8.9
Dry Gas Density	kg/Nm^3	1.3
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	0.99
Stack Gas Velocity	m/sec	15.4
Actual Stack Flow Rate	m^3/min	495
Dry Standard Stack Flow Rate	Nm^3/min	262
Percent Isokinetic Rate	%	102

Pollutant Total Fluorides	Concentration stack conditions mg/m^3	 standard conditions mg/Nm^3	Emission Rate standard conditions g/min
Total fluoride (as HF)	< 0.537	< 1.01	< 0.266

5.3 Trial day 3 – liquid waste

Table 35: Day 3 – PFAS

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPAM0010 - ISOKINETIC
Run ID		11
Test Parameter		PFAS
Test Date	dd/mm/yyyy	28/02/2019
Start Time	hh:mm	8:00:00
End Time	hh:mm	12:24:00
Average Stack Temperature	°C	191
Absolute Stack Pressure	mb	1017
Moisture Content	% v/v	8.4
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	3.49
Stack Gas Velocity	m/sec	16.5
Actual Stack Flow Rate	m^3/min	528
Dry Standard Stack Flow Rate	Nm^3/min	286
Percent Isokinetic Rate	%	110

Pollutant	Concentration stack conditions		Concentration standard conditions		Emission Rate standard conditions	
PFAS species		ng/m^3		ng/Nm^3		g/min
10:2 Fluorotelomersulphonate	<	0.04	<	0.07	<	2.05E-08
4:2 Flurotelomersulphonate	<	0.04	<	0.07	<	2.05E-08
6:2 Fluorotelomersulphonate	<	0.04	<	0.07	<	2.05E-08
8:2 Fluorotelomersulphonate	<	0.04	<	0.07	<	2.05E-08
Perfluorooctane sulfonamide	<	0.04	<	0.07	<	2.05E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.04	<	0.07	<	2.05E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.04	<	0.07	<	2.05E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.08	<	0.14	<	4.10E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.04	<	0.07	<	2.05E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.04	<	0.07	<	2.05E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.08	<	0.14	<	4.10E-08
Perfluorobutanoic acid		1.47		2.72		7.78E-07
Perfluorobutanesulfonic acid	<	0.04	<	0.07	<	2.05E-08
Perfluorodecanoic acid	<	0.04	<	0.07	<	2.05E-08
Perfluorododecanoic acid (PFDoA)	<	0.08	<	0.14	<	4.10E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.04	<	0.07	<	2.05E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.04	<	0.07	<	2.05E-08
Perfluoroheptanoic acid (PFHpA)	<	0.04	<	0.07	<	2.05E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.04	<	0.07	<	2.05E-08
Perfluorohexanoic acid (PFHxA)	<	0.04	<	0.07	<	2.05E-08
Perfluorohexane sulfonate (PFHxS)	<	0.04	<	0.07	<	2.05E-08
Perfluorononanoic acid (PFNA)	<	0.04	<	0.07	<	2.05E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.04	<	0.07	<	2.05E-08
Perfluorooctanoic acid (PFOA)		0.06		0.11		3.28E-08
Perfluorooctane sulfonate (PFOS)	<	0.04	<	0.07	<	2.05E-08
Perfluoropentanoic acid (PFPeA)		1.75		3.23		9.26E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.04	<	0.07	<	2.05E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.04	<	0.07	<	2.05E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.04	<	0.07	<	2.05E-08
Perfluoroundecanoic acid (PFUnA)	<	0.04	<	0.07	<	2.05E-08

Table 36: Day 3 – TOPA

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPAM0010 - ISOKINETIC
Run ID		12
Test Parameter		TOP Assay
Test Date	dd/mm/yyyy	28/02/2019
Start Time	hh:mm	13:40:00
End Time	hh:mm	17:45:00

Average Stack Temperature	°C	195
Absolute Stack Pressure	mb	1017
Moisture Content	% v/v	10.0
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	3.10
Stack Gas Velocity	m/sec	16.1
Actual Stack Flow Rate	m^3/min	516
Dry Standard Stack Flow Rate	Nm^3/min	272
Percent Isokinetic Rate	%	103

Pollutant	Concentration stack conditions		Concentration standard conditions		Emission Rate standard conditions
TOP Assay		ng/m^3		ng/Nm^3	g/min
10:2 Fluorotelomersulphonate	<	0.09	<	0.16	< 4.39E-08
4:2 Flurotelomersulphonate	<	0.09	<	0.16	< 4.39E-08
6:2 Fluorotelomersulphonate	<	0.09	<	0.16	< 4.39E-08
8:2 Fluorotelomersulphonate	<	0.09	<	0.16	< 4.39E-08
Perfluorooctane sulfonamide	<	0.09	<	0.16	< 4.39E-08
N-Ethyl-heptadecafluorooctane sulphonamide	<	0.09	<	0.16	< 4.39E-08
N-Ethyl-perfluorooctane sulphonamidoacetic acid	<	0.09	<	0.16	< 4.39E-08
N-Ethyl-heptadecafluorooctane sulphonamidoethanol	<	0.17	<	0.32	< 8.79E-08
N-Methyl-heptadecafluorooctane sulphonamide	<	0.09	<	0.16	< 4.39E-08
N-Methylperfluorooctane sulphonamidoacetic acid	<	0.09	<	0.16	< 4.39E-08
N-Methyl-heptadecafluorooctane sulphonamidoethanol	<	0.17	<	0.32	< 8.79E-08
Perfluorobutanoic acid	<	0.17	<	0.32	< 8.79E-08
Perfluorobutanesulfonic acid		0.07		0.14	3.78E-08
Perfluorodecanoic acid	<	0.09	<	0.16	< 4.39E-08
Perfluorododecanoic acid (PFDoA)	<	0.17	<	0.32	< 8.79E-08
Perfluoro-1-dodecanesulphonic acid (PFDoS)	<	0.09	<	0.16	< 4.39E-08
Perfluorodecanesulfonic acid (PFDS)	<	0.09	<	0.16	< 4.39E-08
Perfluoroheptanoic acid (PFHpA)	<	0.09	<	0.16	< 4.39E-08
Perfluoroheptane sulfonate (PFHpS)	<	0.09	<	0.16	< 4.39E-08
Perfluorohexanoic acid (PFHxA)	<	0.09	<	0.16	< 4.39E-08
Perfluorohexane sulfonate (PFHxS)	<	0.09	<	0.16	< 4.39E-08
Perfluorononanoic acid (PFNA)	<	0.09	<	0.16	< 4.39E-08
Perfluoro-1-nonanesulphonic acid (PFNS)	<	0.09	<	0.16	< 4.39E-08
Perfluorooctanoic acid (PFOA)	<	0.09	<	0.16	< 4.39E-08
Perfluorooctane sulfonate (PFOS)	<	0.09	<	0.16	< 4.39E-08
Perfluoropentanoic acid (PFPeA)	<	0.71	<	1.36	< 3.69E-07
Perfluoropentane sulfonic acid (PFPeS)	<	0.04	<	0.08	< 2.20E-08
Perfluorotetradecanoic acid (PFTeDA)	<	0.04	<	0.08	< 2.20E-08
Perfluorotridecanoic acid (PFTrDA)	<	0.04	<	0.08	< 2.20E-08
Perfluoroundecanoic acid (PFUnA)	<	0.04	<	0.08	< 2.20E-08

Table 37: Day 3 – Dioxins/furans

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPA M23 - ISOKINETIC
Run ID		8
Test Parameter		PM & PCDD/F
Test Date	dd/mm/yyyy	28/02/2019
Start Time	hh:mm	8:03:00
End Time	hh:mm	11:41:00
Average Stack Temperature	°C	193
Absolute Stack Pressure	mb	1016
Moisture Content	% v/v	9.3
Dry Gas Density	kg/Nm^3	1.30
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	2.38
Stack Gas Velocity	m/sec	15.5
Actual Stack Flow Rate	m^3/min	496
Dry Standard Stack Flow Rate	Nm^3/min	264
Percent Isokinetic Rate	%	102

Pollutant	Concentration stack conditions mg/m^3	Concentration standard conditions mg/Nm^3	Emission Rate standard conditions g/min	Concentration 12% CO_2 mg/Nm^3
Particulate Matter (PM) Concentration				
Stack PM Concentration	< 0.448	< 0.841	< 0.222	< 2.65

Dioxin and Furan (USEPA Method 23)	stack conditions ng/m^3	standard conditions ng/Nm^3	standard conditions g/min	11% O_2 ng/Nm^3
2378 TCDF	0.00260	0.00488	1.29E-09	0.00854
Total TCDF isomers	0.0405	0.0761	2.01E-08	0.133
2378 TCDD	< 0.00109	< 0.00204	< 5.40E-10	< 0.00358
Total TCDD isomers	0.174	0.326	8.61E-08	0.570
12378 PeCDF	0.00385	0.00723	1.91E-09	0.0127
23478 PeCDF	0.00669	0.0126	3.32E-09	0.0220
Total PeCDF isomers	0.0591	0.111	2.93E-08	0.194
12378 PeCDD	0.00607	0.0114	3.01E-09	0.0199
Total PeCDD isomers	0.176	0.330	8.71E-08	0.577
123478 HxCDF	0.00969	0.0182	4.81E-09	0.0319
123678 HxCDF	0.00687	0.0129	3.41E-09	0.0226
234678 HxCDF	0.00790	0.0148	3.92E-09	0.0260
123789 HxCDF	< 0.00396	< 0.00744	< 1.97E-09	< 0.0130
Total HxCDF isomers	0.0463	0.0870	2.30E-08	0.152
123478 HxCDD	0.00533	0.0100	2.64E-09	0.0175
123678 HxCDD	0.0114	0.0213	5.63E-09	0.0373
123789 HxCDD	< 0.0131	< 0.0246	< 6.50E-09	< 0.0431
Total HxCDD isomers	0.178	0.334	8.83E-08	0.585
1234678 HpCDF	0.0186	0.0349	9.23E-09	0.0612
1234789 HpCDF	0.00376	0.00706	1.87E-09	0.0124
Total HpCDF isomers	0.0318	0.0597	1.58E-08	0.105
1234678 HpCDD	0.0434	0.0815	2.15E-08	0.143
Total HpCDD isomers	0.0898	0.169	4.45E-08	0.295
OCDF	0.00853	0.0160	4.23E-09	0.0280
OCDD	0.0410	0.0769	2.03E-08	0.135
Sum of congeners				
Lower	0.844	1.58	4.19E-07	2.78
Medium	0.844	1.58	4.19E-07	2.78
Upper	0.844	1.58	4.19E-07	2.775
Total I-TEQ				
Lower	0.0117	0.0219	5.78E-09	0.0383
Medium	0.0131	0.0245	6.47E-09	0.0429
Upper	0.0144	0.0271	7.17E-09	0.0475

Table 38: Day 3 – Heavy metals

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPA M29 - ISOKINETIC
Run ID		10
Test Parameter		PM & Heavy metals
Test Date	dd/mm/yyyy	28/02/2019
Start Time	hh:mm	14:10:00
End Time	hh:mm	15:32:00
Average Stack Temperature	°C	198
Absolute Stack Pressure	mb	1016
Moisture Content	% v/v	9.4
Dry Gas Density	kg/Nm3	1.30
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	0.97
Stack Gas Velocity	m/sec	15.3
Actual Stack Flow Rate	m^3/min	491
Dry Standard Stack Flow Rate	Nm3/min	258
Percent Isokinetic Rate	%	102

Pollutant Particulate Matter (PM) Concentration	Concentration stack conditions mg/m^3	 standard conditions mg/Nm^3	Emission Rate standard conditions g/min	Concentration 12% CO_2 mg/Nm^3
Stack PM Concentration	3.09	5.86	1.52	17.9

Heavy Metals (USEPA Method 29)	stack conditions $\mu g/m^3$	standard conditions $\mu g/Nm^3$	standard conditions g/min
Arsenic	< 3.06	< 5.82	< 0.00150
Cadmium	0.11	0.21	0.00005
Lead	5.41	10.29	0.00266
Antimony	< 3.06	< 5.82	< 0.00150
Mercury	0.11	0.206	0.00005
Total Heavy Metals (lower bound)	5.63	10.7	0.00277

Table 39: Day 3 – Fluorides

Site		Adelaide
Sample Location		Incinerator stack
Reference Method		USEPA M13b - ISOKINETIC
Run ID		13
Test Parameter		Fluoride
Test Date	dd/mm/yyyy	28/02/2019
Start Time	hh:mm	12:05
End Time	hh:mm	13:28
Average Stack Temperature	°C	195
Absolute Stack Pressure	mb	1016
Moisture Content	% v/v	10.0
Dry Gas Density	kg/Nm3	1.3
Dry Gas Molecular Weight	g/g-mole	29.2
Sample Volume (dry gas meter)	Nm^3	0.96
Stack Gas Velocity	m/sec	15.1
Actual Stack Flow Rate	m^3/min	483
Dry Standard Stack Flow Rate	Nm3/min	254
Percent Isokinetic Rate	%	103

Pollutant Total Fluorides	Concentration stack conditions mg/m^3	 standard conditions mg/Nm^3	Emission Rate standard conditions g/min
Total fluoride (as HF)	< 0.559	< 1.04	< 0.264

Figure 4 below illustrates the combustion gases trend over the sampling period (all isokinetic tests).

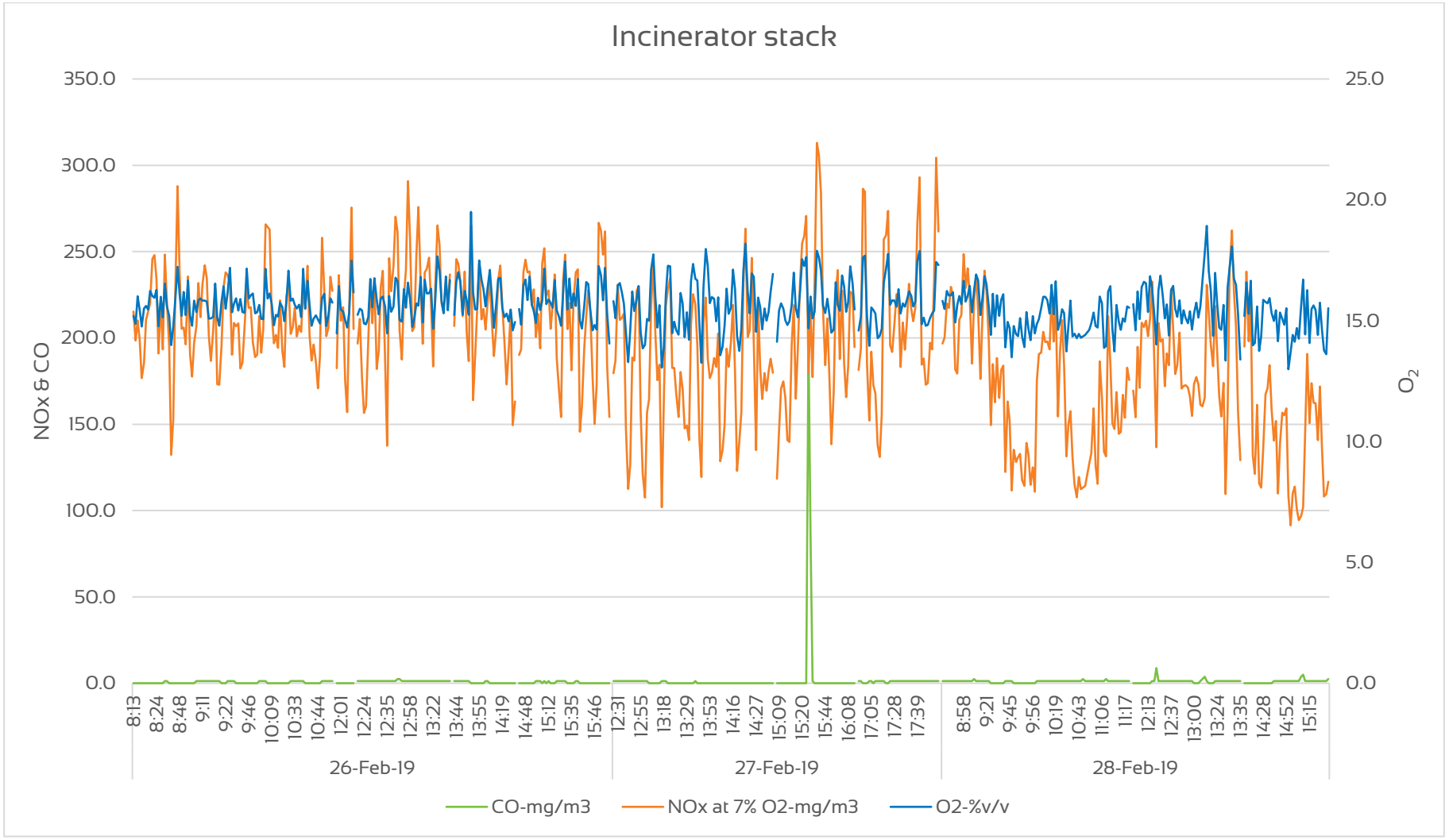

Figure 4: Veolia Adelaide incinerator gases trend

6 DISCUSSION

6.1 PFAS sample results

- Three PFAS compounds were detected on the second day of the trial (Sample 6), PFBA, PFOA & PFPeA.
    - PFBA was detected in similar levels across each of the three days. This compound was not detected in any of the blank samples.
    - PFPeA was detected at varying levels in each sample across the three days. It is noted that PFPeA was also detected in the field blank sample at approximately 30% of the sample result or less.
    - A significant (comparative to other samples) detection of PFOA was made in the day 2 sample. Given the levels, a thorough review of the sampling procedure was performed to determine the validity of the result.
        - Following the detection, the sample was re-prepared and re-analysed, with the second analytical run returned the same result.
        - The PFOA was not present in the field blank, lab blanks, extraction blank or reagent blank.
        - No PFOA was detected in the day 1 sample and only a very small detection on day 3.
        - The TOP Assay sample (Sample 7) performed on day 2 was run simultaneously to the PFAS sample and the TOP Assay sample did not detect any PFOA. If the levels detected in the sample 6 were from the stack, the results of sample 7 should also show some levels of PFOA, which they do not.
        - Considering this last point and that the other samples did not return this level of PFOA, it is unlikely that the elevated level of PFOA in sample 6 is from the stack, rather it is possible that contamination has occurred during the sample media preparation, field sample preparation, recovery or analytical process.