Envirocare CONSULTANCY

2522

Caring for the environment and creating safer workplaces

Report for the Periodic Monitoring of Emissions to Atmosphere

Wyndeham Heron Ltd

Operator:	Wyndeham Heron Ltd
Permit Number:	MLD/EPR/A2/001
Installation:	Print works
Monitoring Dates:	11 – 12 October 2011
Site Address:	The Bethnal Complex Colchester Road Maldon CM9 4NW

Report Number:	J 4848
Version:	1
Date of Report:	20 October 2011
Report Author:	Mr C Mann
MCERTS Registration N°:	MM 06 695
MCERTS Level:	MCERTS Level 2 (TE1, TE2, TE3, TE4)

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Part 1: Executive Summary

1.1 Monitoring Objectives

Wyndeham Heron operate several printing lines that have the potential to release controlled substances to atmosphere, and are subject to authorisation under the Environmental Permitting Regulations (EPR, 2010). Under the act, Local Authorities regulate the printing processes with guidance from the Sector Guidance Note SG6: Surface Treatment using Solvents.

In order for Wyndeham Heron to comply with its annual emission limits they have requested that Envirocare Technical Consultancy undertake a monitoring exercise on all of the thermal oxidiser abatement units and from the waste transport system compactor. The methodologies and results obtained form the basis of this report.

The three Rotoman presses have two print lines that run simultaneously and are located one above the other, each press has its own dryer, each with a duct exiting the dryer and emitting vertically alongside one another. The Lithoman 1 Press has a dedicated dryer. Lithpman 2 was not running at at the date of monitoring due to a recent fire and therefore is not covered by this report.

Emission Point Identification

Substances to Be Monitored	Rotoman 1		Rotoman 2		Rotoman 3		Lithoman 1	Compactor
	Lower	Upper	Lower	Upper	Lower	Upper		
CO	✓	✓	✓	✓	✓	✓	✓	
NOx	✓	✓	✓	✓	✓	✓	✓	
SO_2	✓	✓	✓	✓	✓	✓	✓	
VOCs	✓	✓	✓	✓	✓	✓	✓	
Volumetric Flowrate	✓	✓	✓	✓	✓	✓	✓	
Moisture	✓	✓	✓	✓	✓	✓	✓	
Total Particulate Matter								✓

Opinions and interpretations expressed within this report are outside the scope of Envirocare Technical Consultancies MCERTS and UKAS accreditation.

1.2 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Lithoman 1	Oxides of Nitrogen (as NO_2)	100	**70.8**	mg/Nm^3	5.7	273K, 101.3kPa, WET	11/10/11	09:45 – 13:40	BS EN 14792	MCERTS	Normal
	Carbon Monoxide	100	**66.8**	mg/Nm^3	4.4	273K, 101.3kPa, WET	11/10/11	09:45 – 13:40	BS EN 15058	MCERTS	Normal
	Sulphur Dioxide	None	**9.7**	mg/Nm^3	-	273K, 101.3kPa, WET	11/10/11	09:45 – 13:40	EA TGN M21	MCERTS	Normal
	Total VOC's	20	**0.6**	mg/Nm^3	5.1	273K, 101.3kPa, WET	11/10/11	09:45 – 13:40	BS EN 12619	MCERTS	Normal
	Moisture Content	None	**5.45**	%	-	273K, 101.3kPa	11/10/11	08:22 – 08:52	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	**3050.2**	Nm^3/Hr	-	273K, 101.3kPa	11/10/11	~13:00	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 1 Lower	Oxides of Nitrogen (as NO_2)	100	**55.9**	mg/Nm^3	5.7	273K, 101.3kPa, WET	11/10/11	17:00 – 18:31	BS EN 14792	MCERTS	Normal
	Carbon Monoxide	100	**52.6**	mg/Nm^3	3.7	273K, 101.3kPa, WET	11/10/11	17:00 – 18:31	BS EN 15058	MCERTS	Normal
	Sulphur Dioxide	None	**8.9**	mg/Nm^3	-	273K, 101.3kPa, WET	11/10/11	17:00 – 18:31	EA TGN M21	MCERTS	Normal
	Total VOC's	20	**4.2**	mg/Nm^3	5.2	273K, 101.3kPa, WET	11/10/11	17:00 – 18:31	BS EN 12619	MCERTS	Normal
	Moisture Content	None	**6.73**	%	-	273K, 101.3kPa	11/10/11	17:02 – 17:22	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	**4769.0**	Nm^3/Hr	-	273K, 101.3kPa	11/10/11	~18:30	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 1 Upper	Oxides of Nitrogen (as NO_2)	100	**50.6**	mg/Nm^3	6.6	273K, 101.3kPa, WET	11/10/11	18:31 – 21:01	BS EN 14792	MCERTS	Normal
	Carbon Monoxide	100	**80.6**	mg/Nm^3	3.5	273K, 101.3kPa, WET	11/10/11	18:31 – 21:01	BS EN 15058	MCERTS	Normal
	Sulphur Dioxide	None	**9.1**	mg/Nm^3	-	273K, 101.3kPa, WET	11/10/11	18:31 – 21:01	EA TGN M21	MCERTS	Normal
	Total VOC's	20	**3.3**	mg/Nm^3	5.2	273K, 101.3kPa, WET	11/10/11	18:31 – 21:01	BS EN 12619	MCERTS	Normal
	Moisture Content	None	**3.95**	%	-	273K, 101.3kPa	11/10/11	19:30 – 20:28	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	**5495.6**	Nm^3/Hr	-	273K, 101.3kPa	11/10/11	~20:30	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 2 Lower	Oxides of Nitrogen (as NO_2)	100	**67.6**	mg/Nm^3	4.2	273K, 101.3kPa, WET	12/10/11	09:36 – 13:39	BS EN 14792	MCERTS	Normal
	Carbon Monoxide	100	**45.5**	mg/Nm^3	4.1	273K, 101.3kPa, WET	12/10/11	09:36 – 13:39	BS EN 15058	MCERTS	Normal
	Sulphur Dioxide	None	**11.0**	mg/Nm^3	-	273K, 101.3kPa, WET	12/10/11	09:36 – 13:39	EA TGN M21	MCERTS	Normal
	Total VOC's	20	**0.7**	mg/Nm^3	5.1	273K, 101.3kPa, WET	12/10/11	09:36 – 13:39	BS EN 12619	MCERTS	Normal
	Moisture Content	None	**6.25**	%	-	273K, 101.3kPa	12/10/11	13:25 – 13:35	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	**3381.4**	Nm^3/Hr	-	273K, 101.3kPa	12/10/11	~12:00	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 2 Upper	Oxides of Nitrogen (as NO_2)	100	**70.0**	mg/Nm^3	3.4	273K, 101.3kPa, WET	12/10/11	13:45 – 15:03	BS EN 14792	MCERTS	Normal
	Carbon Monoxide	100	**31.6**	mg/Nm^3	4.5	273K, 101.3kPa, WET	12/10/11	13:45 – 15:03	BS EN 15058	MCERTS	Normal
	Sulphur Dioxide	None	**6.7**	mg/Nm^3	-	273K, 101.3kPa, WET	12/10/11	13:45 – 15:03	EA TGN M21	MCERTS	Normal
	Total VOC's	20	**0.4**	mg/Nm^3	5.1	273K, 101.3kPa, WET	12/10/11	13:45 – 15:03	BS EN 12619	MCERTS	Normal
	Moisture Content	None	**8.91**	%	-	273K, 101.3kPa	12/10/11	14:15 – 14:35	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	**2076.0**	Nm^3/Hr	-	273K, 101.3kPa	12/10/11	~14:45	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 3 Lower	Oxides of Nitrogen (as NO_2)	100	62.2	mg/Nm^3	4.5	273K, 101.3kPa, WET	12/10/11	15:45 – 17:09	BS EN 14792	MCERTS	Normal
	Carbon Monoxide	100	50.4	mg/Nm^3	4.0	273K, 101.3kPa, WET	12/10/11	15:45 – 17:09	BS EN 15058	MCERTS	Normal
	Sulphur Dioxide	None	6.8	mg/Nm^3	-	273K, 101.3kPa, WET	12/10/11	15:45 – 17:09	EA TGN M21	MCERTS	Normal
	Total VOC's	20	0.1	mg/Nm^3	5.1	273K, 101.3kPa, WET	12/10/11	15:45 – 17:09	BS EN 12619	MCERTS	Normal
	Moisture Content	None	4.77	%	-	273K, 101.3kPa	12/10/11	16:15 – 16:35	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	2987.8	Nm^3/Hr	-	273K, 101.3kPa	12/10/11	~16:45	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 3 Upper	Oxides of Nitrogen (as NO_2)	100	56.4	mg/Nm^3	6.2	273K, 101.3kPa, WET	12/10/11	17:55 – 18:56	BS EN 14792	MCERTS	Normal
	Carbon Monoxide	100	75.7	mg/Nm^3	3.7	273K, 101.3kPa, WET	12/10/11	17:55 – 18:56	BS EN 15058	MCERTS	Normal
	Sulphur Dioxide	None	7.1	mg/Nm^3	-	273K, 101.3kPa, WET	12/10/11	17:55 – 18:56	EA TGN M21	MCERTS	Normal
	Total VOC's	20	1.0	mg/Nm^3	5.1	273K, 101.3kPa, WET	12/10/11	17:55 – 18:56	BS EN 12619	MCERTS	Normal
	Moisture Content	None	4.02	%	-	273K, 101.3kPa	12/10/11	17:55 – 18:25	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	3495.3	Nm^3/Hr	-	273K, 101.3kPa	12/10/11	~18:30	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Compactor	Total Particulate Matter	50#	4.44	mg/Nm^3	-	273K, 101.3kPa	12/10/11	10:35 – 13:54	MDHS 14/3	None	Normal

Assumed

1.3 Operating Information

Emission Point Reference	Date	Process Type	Process Duration	Fuel	Feedstock	Abatement	Press Speed	Comparison of Operator CEMS and Periodic Monitoring Results			
								Substance	CEMS Results	Periodic Monitoring Results	Units
Lithoman 1	11/10/11	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	64,000 cph	N/A	N/A	N/A	N/A
Rotoman 1 Lower	11/10/11	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	35,000 cph	N/A	N/A	N/A	N/A
Rotoman 1 Upper	11/10/11	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	35,000 cph	N/A	N/A	N/A	N/A
Rotoman 2 Lower	12/10/11	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	46,000 cph	N/A	N/A	N/A	N/A
Rotoman 2 Upper	12/10/11	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	45,000 cph	N/A	N/A	N/A	N/A
Rotoman 3 Lower	12/10/11	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	40,000 cph	N/A	N/A	N/A	N/A
Rotoman 3 Upper	12/10/11	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	40,000 cph	N/A	N/A	N/A	N/A
Compactor	12/10/11	Collection of offcuts from binding	Continuous	None	Paper offcuts	Bag Filter	N/A	N/A	N/A	N/A	N/A

1.4 Monitoring Deviations

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
Lithoman 1	None	None	None
Rotoman 1 Lower	None	None	None
Rotoman 1 Upper	None	None	None
Rotoman 2 Lower	None	None	None
Rotoman 2 Upper	None	None	None
Rotoman 3 Lower	None	None	None
Rotoman 3 Upper	None	None	None
Compactor	None	None	None

Part 2: Supporting Information

2.1 Appendix 1: General Information

2.1.1 Monitoring organisation staff details

Personnel	Function in monitoring campaign	MCERTS Level	MCERTS Number
Mr C G Mann	Team Leader	MCERTS Level 2 (TE1, TE2, TE3, TE4)	MM 06 695
Mr J Piatka	Technician	MCERTS Level 1	MM 10 1110

Change depending on role

2.1.2 Monitoring Methods

Pollutant Species	Standard	Technique	Envirocare Internal Procedure
Total VOC's	BS EN 12619	FID	ETC-M-03
Moisture	US EPA M4	Gravimetric	ETC-M-07
Carbon Monoxide	BS EN 15058	NDIR	ETC-M-25
Oxygen	BS EN 14789	Zirconium Cell	ETC-M-25
Oxides of Nitrogen	BS EN 14792	Chemiluminescence	ETC-M-25
Stack Temperature + Velocity	BS EN 13284	Pitot Tube + Thermocouple	ETC-M-46

2.1.3 Equipment Checklist

Equipment ID	Model Number	Purpose
Horiba 1	Horiba PG250	Multi component gas analyser
Sig 1	Signal 3030pm	Flame Ionisation Detector
Sig 2	Signal 3030pm	Flame Ionisation Detector
HL3	Signal Heated Line	PTFE Cored heated sample line
GPU2	Testo 339	Heated line controller and peltier cooler
GPU3	Signal 2020SM	Peltier Cooler
THL5	-	PTFE Cored heated sample line

2.2 Appendix 2: Lithoman 1 Results and Calculations

2.2.1 Photograph of the sampling location and positions

2.2.2 Flow criteria measurements

Lithoman 1		
Pitot Coefficient:	**0.847**	
Duct dimensions:	**55.0**	**cm**
Barometric pressure:	**1015**	**mbar**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s) Uncorrd.	Velocity (m/s) Corrd.	Temp (°C)
Single	A1	0.05	2.8	8.6	10.7	370
	A2	0.15	8.3	7.1	9.0	370
	A3	0.25	13.8	4.0	5.1	370
	A4	0.35	19.3	6.7	8.4	370
	A5	0.45	24.8	5.1	6.4	370
	A6	0.55	30.3	8.6	10.8	370
	A7	0.65	35.8			
	A8	0.75	41.3			
	A9	0.85	46.8			
	A10	0.95	52.3			

Velocity readings (m/s)

Duct Mean m/s	**8.4**			
Highest(a)	10.8	Lowest (b)	5.1	

Temperature readings

Duct Mean °C	**370**		
Duct Mean K		643	
Highest(a)	370.0	Lowest (b)	370.0

Volumetic flow rate

Duct dimensions	55.0	(cm)
Duct area	0.238	(m^2)
Mean duct velocity	8.4	(m/s)
Mean duct temperature	370	(^oC)
Ambient pressure	1015	(mbar)
Vol. Flow rate at stack conditions	**7170**	**(m^3/hr)**
Vol flow rate corrd.	**3050.2**	**(Nm^3/hr)**

2.2.3 Water vapour measurements

Stack Reference:	Lithoman 1		
Ambient Pressure (mbar):	1015	**Gasmeter Coefficient:**	1.0000
Equipment used:	SKC Sidepak	**Mean Gasmeter Temp. (°C):**	30

End Flowrate Reading (l/min)	1.242
Start Flowrate Reading (l/min)	1.31
Volume Sampled (l)	38.3
Corrected Volume Sampled (l)	34.6

End Time	08:52:00
Start Time	08:22:00
Total Time mins	30.00

	IMPINGER	
	1	**2**
End Weight of Impingers (g)	90.6	94.9
Start Weight of Impingers (g)	89.4	94.5
Weight Gain (g)	1.2	0.4

Total Weight Gain (1+2+3+4) (g	1.6
Total Weight Gain in litres (l)	1.99

Moisture Content of Gases (%)	**5.45**

2.2.4 Manual monitoring method - results – calculations
Not applicable

2.2.5 Analysis results
Not applicable

2.2.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Lithoman 1 (11/10/11)

Data entered by: CM

Horiba Analyser: Horiba 1

Signal Analyser: Sig 2

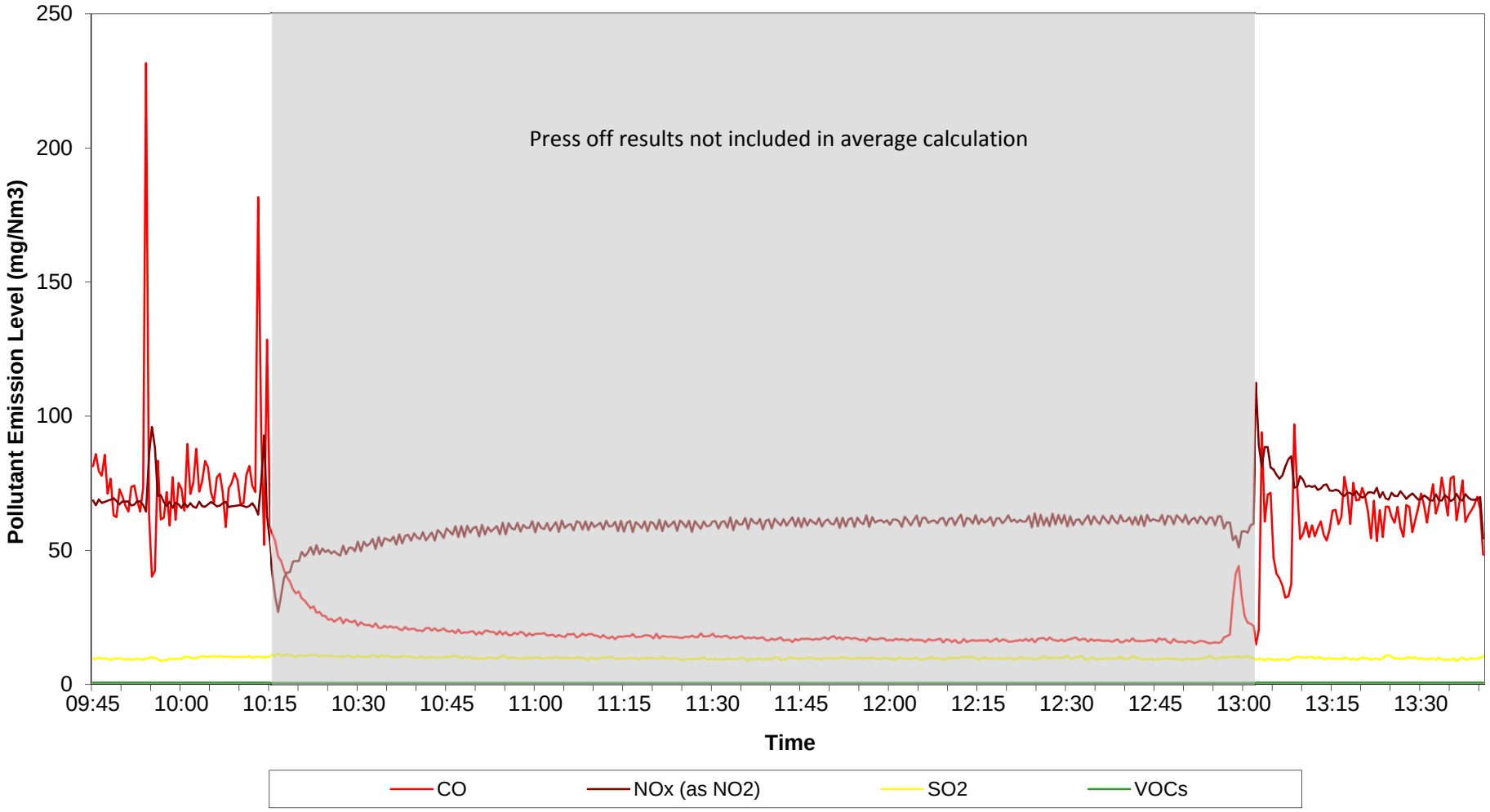
Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	80.1	ppm +/-2%	49.3	ppm +/-2%	151.9	ppm +/-2%	8.10	ppm +/-2%
Period								
Span PreCal direct to analyser	80.8	ppm	49.2	ppm	151.9	ppm	8.2	ppm
Zero PreCal through sample line	0.6	ppm	0.1	ppm	1.3	ppm	-0.2	ppm
Span PreCal through sample line	80.4	ppm	49.2	ppm	149.3	ppm	8.4	ppm
Zero PostCal through sample line	1.2	ppm	0.5	ppm	0.7	ppm	-0.2	ppm
Span PostCal through sample line	80.0	ppm	48.9	ppm	147.8	ppm	8.0	ppm
Span Drift	0.5	%	0.6	%	1.0	%		
Zero Drift	-0.8	%	-0.8	%	0.3	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

2.2.7 Instrumental gas analyser results

Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers
Wyndeham Heron, Maldon
Combustion Gas and VOC Emissions from Lithoman 1 (11/10/11)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm³ WET			
					CO (mg/Nm³)	NOx (as NO_2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	**56.5**	**36.5**	**3.6**	**0.4**	**66.8**	**70.8**	**9.7**	**0.6**
Maximum	196.0	58.0	4.0	0.4	231.6	112.5	10.8	0.6
Minimum	12.5	28.0	3.2	0.4	14.8	54.4	8.7	0.6

Combustion Gas and VOC Emissions from Lithoman 1
Wyndeham Heron, Maldon (11/10/11)



2.2.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	56.54	ppm
Span Gas Certified Value =	80.1	ppm +/-2%
Emission Limit Value	100	mg/Nm³

Parameter	criteria	U	U^2
Repeatability	1% of value	0.5654	0.3197
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	1.1309	1.2789
Linearity	0.76% of value	0.4297	0.1847
Setting Gas Divider	0.25% of value	0.1414	0.0200
Interference	2.9% of value	1.6398	2.6889
Span Gas	1% of span gas	0.8010	0.6416
		Sum U^2	5.38
		Combined Standard Uncertainty (ppm]	2.32
		Expanded Total Uncertainty (ppm) (95% Confidence)	4.55
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	8.0
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	5.69
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.7

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	36.48	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm³

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.3648	0.1331
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.6931	0.4804
Linearity	0.49% of value	0.1788	0.0320
Setting Gas Divider	0.25% of value	0.0912	0.0083
Interference	1.2% of value	0.4378	0.1916
Span Gas	1% of span gas	0.4930	0.2430
		Sum U^2	1.18
		Combined Standard Uncertainty (ppm)	1.09
		Expanded Total Uncertainty (ppm) (95% Confidence)	2.13
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	5.8
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	4.37
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.4

UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =	3.597619046	ppm
Span Gas Certified Value =	151.9	ppm

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0360	0.0013
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0684	0.0047
Linearity	1.53% of value	0.0550	0.0030
Setting Gas Divider	0.25% of value	0.0090	0.0001
Interference	1.2% of value	0.0432	0.0019
Span Gas	1% of span gas	1.5190	2.3074
		Sum U^2	2.41
		Combined Standard Uncertainty (ppm)	1.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.04
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	84.5
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	8.69

UNCERTAINTY OF VOC BY SIGNAL 2

Reading =	0.4	ppm as C3H8
Span Gas=	8.10	ppm+/-2%
Emission Limit Value	20	mg/Nm³ as carbon

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0040	0.0000
Zero Drift/ Detection threshold	0.3ppm	0.3000	0.0900
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.5% of value	0.0040	0.0000
Setting Gas Divider	0.25% of value	0.0010	0.0000
Temperature Drift	1% of value	0.0040	0.0000
Span Gas	1% of Value	0.0810	0.0066
		Sum U^2	0.11
		Combined Standard Uncertainty (ppm as C3H8]	0.33
		Expanded Total Uncertainty (ppm as C3H8] (95% Confidence)	0.64
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	160.0
		Expanded Total Uncertainty (mg/Nm^3 as carbon) (95% Confidence)	1.03
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.1

2.3 Appendix 3: Rotoman 1 Lower Results and Calculations

2.3.1 Photograph of the sampling location and positions

2.3.2 Flow criteria measurements

Rotoman 1 Lower

Pitot Coefficient:	**0.847**	
Duct dimensions:	**60.0**	**cm**
Barometric pressure:	**1015**	**mbar**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorrd.	Corrd.	
Single	A1	0.05	3.0	8.9	10.9	345
	A2	0.15	9.0	8.8	10.8	345
	A3	0.25	15.0	8.8	10.8	345
	A4	0.35	21.0	8.8	10.8	345
	A5	0.45	27.0	8.7	10.7	345
	A6	0.55	33.0	8.6	10.6	345
	A7	0.65	39.0	8.5	10.4	345
	A8	0.75	45.0	8.1	10.0	345
	A9	0.85	51.0	10.4	12.8	345
	A10	0.95	57.0	6.5	8.0	345

Velocity readings (m/s)

Duct Mean m/s	**10.6**			
Highest(a)	12.8	Lowest (b)	8.0	

Temperature readings

Duct Mean °C	**345**		
Duct Mean K		618	
Highest(a)	345.0	Lowest (b)	345.0

Volumetic flow rate

Duct dimensions	60.0	(cm)
Duct area	0.283	(m^2)
Mean duct velocity	10.6	(m/s)
Mean duct temperature	345	(^oC)
Ambient pressure	1015	(mbar)
Vol. Flow rate at stack conditions	**10774**	**(m^3/hr)**
Vol flow rate corrd.	**4769.0**	**(Nm^3/hr)**

2.3.3 Water vapour measurements

Stack Reference:	Rotoman 1 Lower		
Ambient Pressure (mbar):	1015	**Gasmeter Coefficient:**	1.0000
Equipment used:	SKC Sidepak	**Mean Gasmeter Temp. (°C):**	35

End Flowrate Reading (l/min)	1.273
Start Flowrate Reading (l/min)	1.252
Volume Sampled (l)	25.3
Corrected Volume Sampled (l)	22.4

End Time	17:22:00
Start Time	17:02:00
Total Time mins	20.00

	IMPINGER	
	1	**2**
End Weight of Impingers (g)	93.3	89.3
Start Weight of Impingers (g)	92.3	89
Weight Gain (g)	1.0	0.3

Total Weight Gain (1+2+3+4) (g	1.3
Total Weight Gain in litres (l)	1.62

Moisture Content of Gases (%)	**6.73**

2.3.4 Manual monitoring method - results – calculations
Not applicable

2.3.5 Analysis results
Not applicable

2.3.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 1 LOWER (11/10/11)

Data entered by: CM

Horiba Analyser: Horiba 1

Signal Analyser: SIG1

Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	80.1	ppm +/-2%	49.3	ppm +/-2%	151.9	ppm +/-2%	8.10	ppm +/-2%
Period								
Span PreCal direct to analyser	80.6	ppm	449.2	ppm	152.4	ppm	8.0	ppm
Zero PreCal through sample line	0.2	ppm	0.1	ppm	1.5	ppm	0.1	ppm
Span PreCal through sample line	80.1	ppm	49.8	ppm	151.3	ppm	8.1	ppm
Zero PostCal through sample line	1.3	ppm	0.1	ppm	0.4	ppm	0.5	ppm
Span PostCal through sample line	81.1	ppm	48.9	ppm	148.8	ppm	7.8	ppm
Span Drift	-1.3	%	1.8	%	1.7	%		
Zero Drift	-1.4	%	-0.1	%	0.8	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

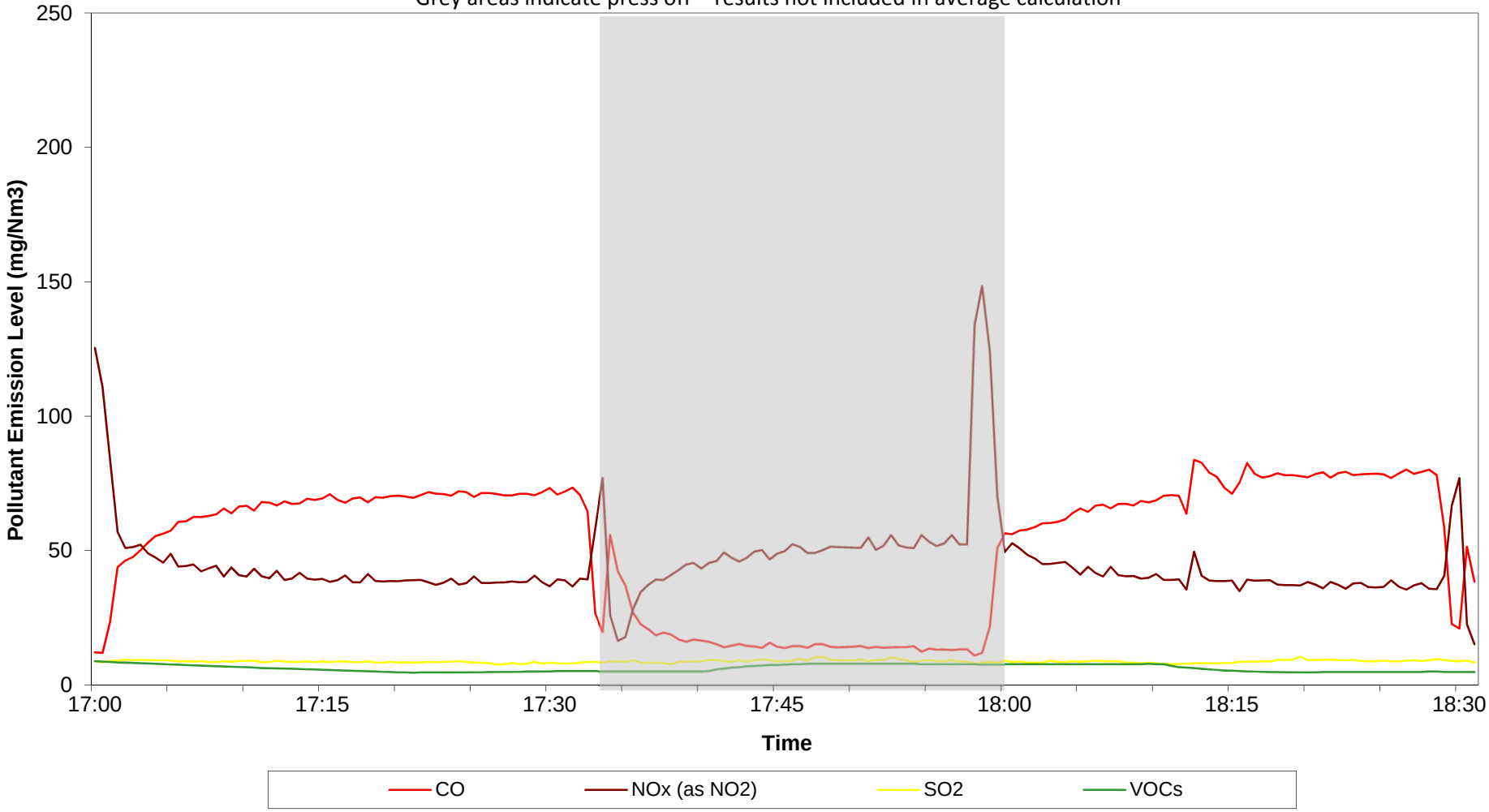
2.3.7 Instrumental gas analyser results

Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers
Wyndeham Heron, Maldon
Combustion Gas and VOC Emissions from Rotoman 1 LOWER (11/10/11)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm³			
					CO (mg/Nm³)	NOx (as NO_2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	56.6	27.9	3.2	2.6	52.6	55.9	8.9	4.2
Maximum	108.2	65.5	4.0	5.5	135.3	125.4	11.5	8.8
Minimum	10.2	19.4	2.8	1.7	11.9	37.2	7.6	2.7

Combustion Gas and VOC Emissions from Rotoman 1 LOWER
Wyndeham Heron, Maldon (11/10/11)

Grey areas indicate press off - results not included in average calculation



2.3.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	56.56	ppm
Span Gas Certified Value =	80.1	ppm +/-2%
Emission Limit Value	100	mg/Nm³

Parameter	criteria	U	U^2
Repeatability	1% of value	0.5656	0.3200
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	1.1313	1.2798
Linearity	0.76% of value	0.4299	0.1848
Setting Gas Divider	0.25% of value	0.1414	0.0200
Interference	2.9% of value	1.6404	2.6908
Span Gas	1% of span gas	0.8010	0.6416
		Sum U^2	5.39
		Combined Standard Uncertainty (ppm]	2.32
		Expanded Total Uncertainty (ppm) (95% Confidence)	4.55
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	8.0
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	5.69
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.7

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	27.88	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm³

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.2788	0.0778
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.5298	0.2807
Linearity	0.49% of value	0.1366	0.0187
Setting Gas Divider	0.25% of value	0.0697	0.0049
Interference	1.2% of value	0.3346	0.1120
Span Gas	1% of span gas	0.4930	0.2430
		Sum U^2	0.83
		Combined Standard Uncertainty (ppm)	0.91
		Expanded Total Uncertainty (ppm) (95% Confidence)	1.78
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	6.4
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	3.66
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	3.7

UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =	3.219761905	ppm
Span Gas Certified Value =	151.9	ppm

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0322	0.0010
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0612	0.0037
Linearity	1.53% of value	0.0493	0.0024
Setting Gas Divider	0.25% of value	0.0080	0.0001
Interference	1.2% of value	0.0386	0.0015
Span Gas	1% of span gas	1.5190	2.3074
		Sum U^2	2.41
		Combined Standard Uncertainty (ppm)	1.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.04
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	94.4
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	8.69

UNCERTAINTY OF VOC BY SIGNAL 1

Reading =	2.636428571	ppm as C3H8
Span Gas=	8.10	ppm+/-2%
Emission Limit Value	20	mg/Nm³ as carbon

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0264	0.0007
Zero Drift/ Detection threshold	0.3ppm	0.3000	0.0900
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.5% of value	0.0264	0.0007
Setting Gas Divider	0.25% of value	0.0066	0.0000
Temperature Drift	1% of value	0.0264	0.0007
Span Gas	1% of Value	0.0810	0.0066
		Sum U^2	0.11
		Combined Standard Uncertainty (ppm as C3H8]	0.33
		Expanded Total Uncertainty (ppm as C3H8] (95% Confidence)	0.65
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	24.5
		Expanded Total Uncertainty (mg/Nm^3 as carbon) (95% Confidence)	1.04
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.2

2.4 Appendix 4: Rotoman 1 Upper Results and Calculations

2.4.1 Photograph of the sampling location and positions

2.4.2 Flow criteria measurements

Rotoman 1 Upper

Pitot Coefficient:	**0.847**	
Duct dimensions:	**60.0**	**cm**
Barometric pressure:	**1015**	**mbar**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s) Uncorrd.	Velocity (m/s) Corrd.	Temp (°C)
Single	A1	0.05	3.0	10.1	12.5	351
	A2	0.15	9.0	9.6	11.9	351
	A3	0.25	15.0	9.3	11.5	351
	A4	0.35	21.0	10.9	13.5	351
	A5	0.45	27.0	10.7	13.2	351
	A6	0.55	33.0	10.5	13.0	351
	A7	0.65	39.0	10.4	12.8	351
	A8	0.75	45.0	8.7	10.7	351
	A9	0.85	51.0	9.8	12.1	351
	A10	0.95	57.0	9.7	12.0	351

Velocity readings (m/s)

Duct Mean m/s	**12.3**			
Highest(a)	13.5	Lowest (b)	10.7	

Temperature readings

Duct Mean °C	**351**		
Duct Mean K		624	
Highest(a)	351.0	Lowest (b)	351.0

Volumetic flow rate

Duct dimensions	60.0	(cm)
Duct area	0.283	(m^2)
Mean duct velocity	12.3	(m/s)
Mean duct temperature	351	(^oC)
Ambient pressure	1015	(mbar)
Vol. Flow rate at stack conditions	**12537**	**(m^3/hr)**
Vol flow rate corrd.	**5495.6**	**(Nm^3/hr)**

2.4.3 Water vapour measurements

Stack Reference:	Rotoman 1 Upper		
Ambient Pressure (mbar):	1015	**Gasmeter Coefficient:**	1.0000
Equipment used:	SKC Sidepak	**Mean Gasmeter Temp. (°C):**	35

End Flowrate Reading (l/min)	0.971
Start Flowrate Reading (l/min)	1.263
Volume Sampled (l)	64.8
Corrected Volume Sampled (l)	57.5

End Time	20:28:00
Start Time	19:30:00
Total Time mins	58.00

	IMPINGER	
	1	**2**
End Weight of Impingers (g)	92.9	91.7
Start Weight of Impingers (g)	91.5	91.2
Weight Gain (g)	1.4	0.5

Total Weight Gain (1+2+3+4) (g	1.9
Total Weight Gain in litres (l)	2.37

Moisture Content of Gases (%)	**3.95**

2.4.4 Manual monitoring method - results – calculations
Not applicable

2.4.5 Analysis results
Not applicable

2.4.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 1 UPPER (11/10/11)

Data entered by: CM

Horiba Analyser: Horiba 1

Signal Analyser: SIG1

Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	80.1	ppm +/-2%	49.3	ppm +/-2%	151.9	ppm +/-2%	8.10	ppm +/-2%
Period								
Span PreCal direct to analyser	80.6	ppm	449.2	ppm	152.4	ppm	8.0	ppm
Zero PreCal through sample line	0.2	ppm	0.1	ppm	1.5	ppm	0.1	ppm
Span PreCal through sample line	80.1	ppm	49.8	ppm	151.3	ppm	8.1	ppm
Zero PostCal through sample line	1.3	ppm	0.1	ppm	0.4	ppm	0.5	ppm
Span PostCal through sample line	81.1	ppm	48.9	ppm	148.8	ppm	7.8	ppm
Span Drift	-1.3	%	1.8	%	1.7	%		
Zero Drift	-1.4	%	-0.1	%	0.8	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

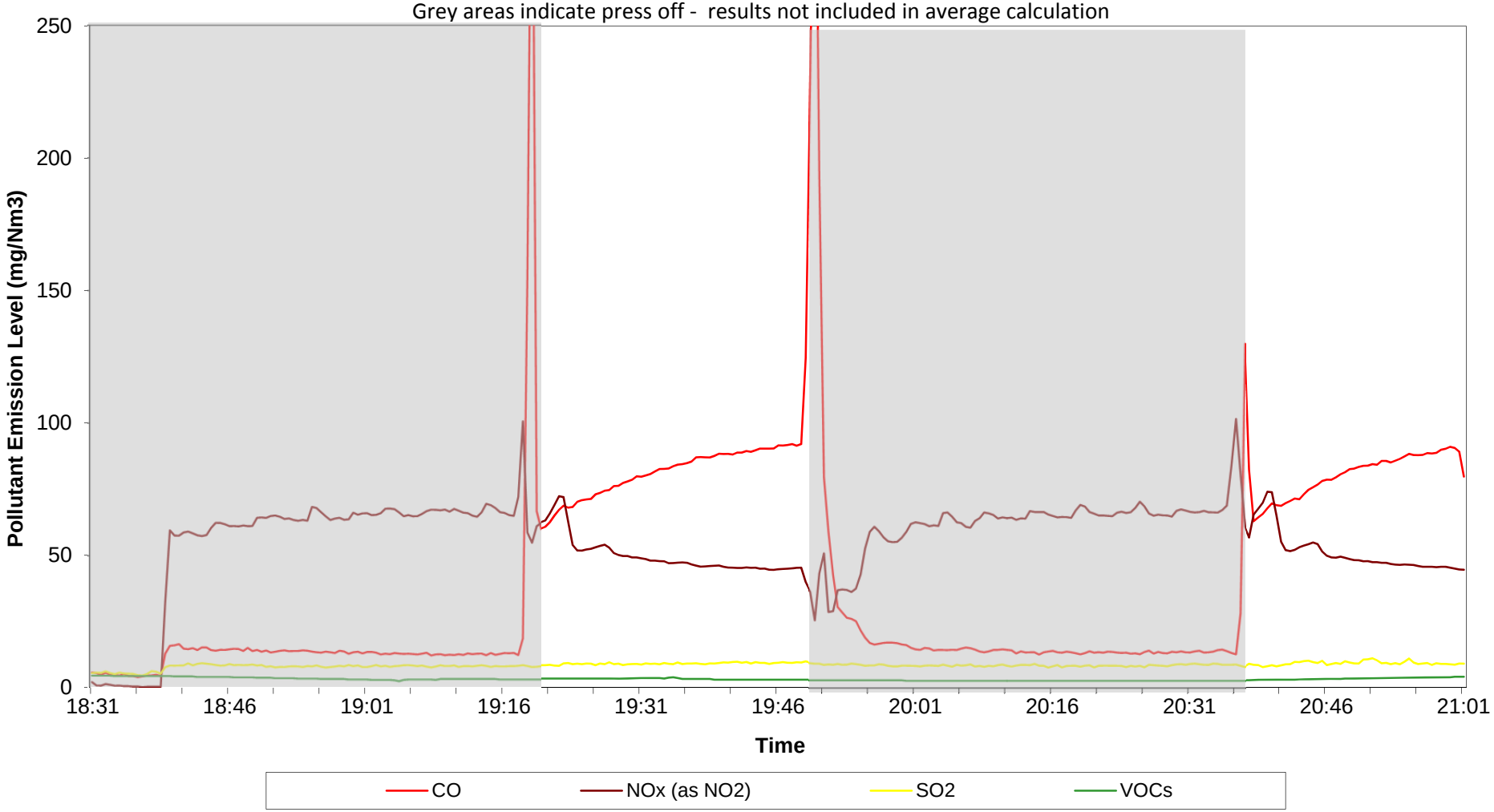
2.4.7 Instrumental gas analyser results

Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers
Wyndeham Heron, Maldon
Combustion Gas and VOC Emissions from Rotoman 1 UPPER (11/10/11)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm³ WET			
					CO (mg/Nm³)	NOx (as NO_2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	**67.1**	**25.7**	**3.3**	**2.0**	**80.6**	**50.6**	**9.1**	**3.3**
Maximum	**76.6**	**37.5**	**4.0**	**2.5**	**92.0**	**74.0**	**11.0**	**4.0**
Minimum	**50.0**	**22.5**	**2.8**	**1.7**	**60.0**	**44.4**	**7.7**	**2.7**

Combustion Gas and VOC Emissions from Rotoman 1 UPPER
Wyndeham Heron, Maldon (11/10/11)

Grey areas indicate press off - results not included in average calculation



2.4.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	67.14	ppm
Span Gas Certified Value =	80.1	ppm +/-2%
Emission Limit Value	100	mg/Nm³

Parameter	criteria	U	U^2
Repeatability	1% of value	0.6714	0.4508
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	1.3428	1.8031
Linearity	0.76% of value	0.5103	0.2604
Setting Gas Divider	0.25% of value	0.1678	0.0282
Interference	2.9% of value	1.9470	3.7910
Span Gas	1% of span gas	0.8010	0.6416
		Sum U^2	7.22
		Combined Standard Uncertainty (ppm]	2.69
		Expanded Total Uncertainty (ppm) (95% Confidence)	5.27
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	7.8
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	6.59
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	6.6

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	25.67	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm³

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.2567	0.0659
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.4877	0.2378
Linearity	0.49% of value	0.1258	0.0158
Setting Gas Divider	0.25% of value	0.0642	0.0041
Interference	1.2% of value	0.3080	0.0949
Span Gas	1% of span gas	0.4930	0.2430
		Sum U^2	0.75
		Combined Standard Uncertainty (ppm)	0.87
		Expanded Total Uncertainty (ppm) (95% Confidence)	1.70
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	6.6
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	3.49
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	3.5

UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =	3.307009349	ppm
Span Gas Certified Value =	151.9	ppm

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0331	0.0011
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0628	0.0039
Linearity	1.53% of value	0.0506	0.0026
Setting Gas Divider	0.25% of value	0.0083	0.0001
Interference	1.2% of value	0.0397	0.0016
Span Gas	1% of span gas	1.5190	2.3074
		Sum U^2	2.41
		Combined Standard Uncertainty (ppm)	1.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.04
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	91.9
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	8.69

UNCERTAINTY OF VOC BY SIGNAL 1

Reading =	2.05	ppm as C3H8
Span Gas=	8.10	ppm+/-2%
Emission Limit Value	20	mg/Nm³ as carbon

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0205	0.0004
Zero Drift/ Detection threshold	0.3ppm	0.3000	0.0900
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.5% of value	0.0205	0.0004
Setting Gas Divider	0.25% of value	0.0051	0.0000
Temperature Drift	1% of value	0.0205	0.0004
Span Gas	1% of Value	0.0810	0.0066
		Sum U^2	0.11
		Combined Standard Uncertainty (ppm as C3H8]	0.33
		Expanded Total Uncertainty (ppm as C3H8] (95% Confidence)	0.64
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	31.4
		Expanded Total Uncertainty (mg/Nm^3 as carbon) (95% Confidence)	1.03
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.2

2.5 Appendix 5: Rotoman 2 Lower Results and Calculations

2.5.1 Photograph of the sampling location and positions

2.5.2 Flow criteria measurements

Rotoman 2 Lower

Pitot Coefficient:	**0.847**	
Duct dimensions:	**50.0**	**cm**
Barometric pressure:	**1001**	**mbar**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s) Uncorrd.	Velocity (m/s) Corrd.	Temp (°C)
Single	A1	0.05	2.5	8.7	10.8	350
	A2	0.15	7.5	8.8	10.9	350
	A3	0.25	12.5	8.7	10.8	350
	A4	0.35	17.5	8.9	11.1	350
	A5	0.45	22.5	8.4	10.4	350
	A6	0.55	27.5	8.4	10.4	350
	A7	0.65	32.5	9.5	11.8	350
	A8	0.75	37.5	9.5	11.7	350
	A9	0.85	42.5	9.3	11.5	350
	A10	0.95	47.5	8.8	11.0	350

Velocity readings (m/s)

Duct Mean m/s	**11.0**			
Highest(a)	11.8	Lowest (b)	10.4	

Temperature readings

Duct Mean °C	**350**		
Duct Mean K		623	
Highest(a)	350.0	Lowest (b)	350.0

Volumetic flow rate

Duct dimensions	50.0	(cm)
Duct area	0.196	(m^2)
Mean duct velocity	11.0	(m/s)
Mean duct temperature	350	(^oC)
Ambient pressure	1001	(mbar)
Vol. Flow rate at stack conditions	**7809**	**(m^3/hr)**
Vol flow rate corrd.	**3381.4**	**(Nm^3/hr)**

2.5.3 Water vapour measurements

Stack Reference:	Rotoman 2 Lower		
Ambient Pressure (mbar):	1001	**Gasmeter Coefficient:**	1.0000
Equipment used:	SKC Sidepak	**Mean Gasmeter Temp. (°C):**	32

End Flowrate Reading (l/min)	1.585
Start Flowrate Reading (l/min)	1.584
Volume Sampled (l)	31.7
Corrected Volume Sampled (l)	28.0

End Time	13:35:00
Start Time	13:15:00
Total Time mins	20.00

	IMPINGER	
	1	**2**
End Weight of Impingers (g)	91.2	91.5
Start Weight of Impingers (g)	91.1	90.1
Weight Gain (g)	0.1	1.4

Total Weight Gain (1+2+3+4) (g	1.5
Total Weight Gain in litres (l)	1.87

Moisture Content of Gases (%)	**6.25**

2.5.4 Manual monitoring method - results – calculations
Not applicable

2.5.5 Analysis results
Not applicable

2.5.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 2 LOWER (12/10/11)

Data entered by: CM

Horiba Analyser: Horiba 1

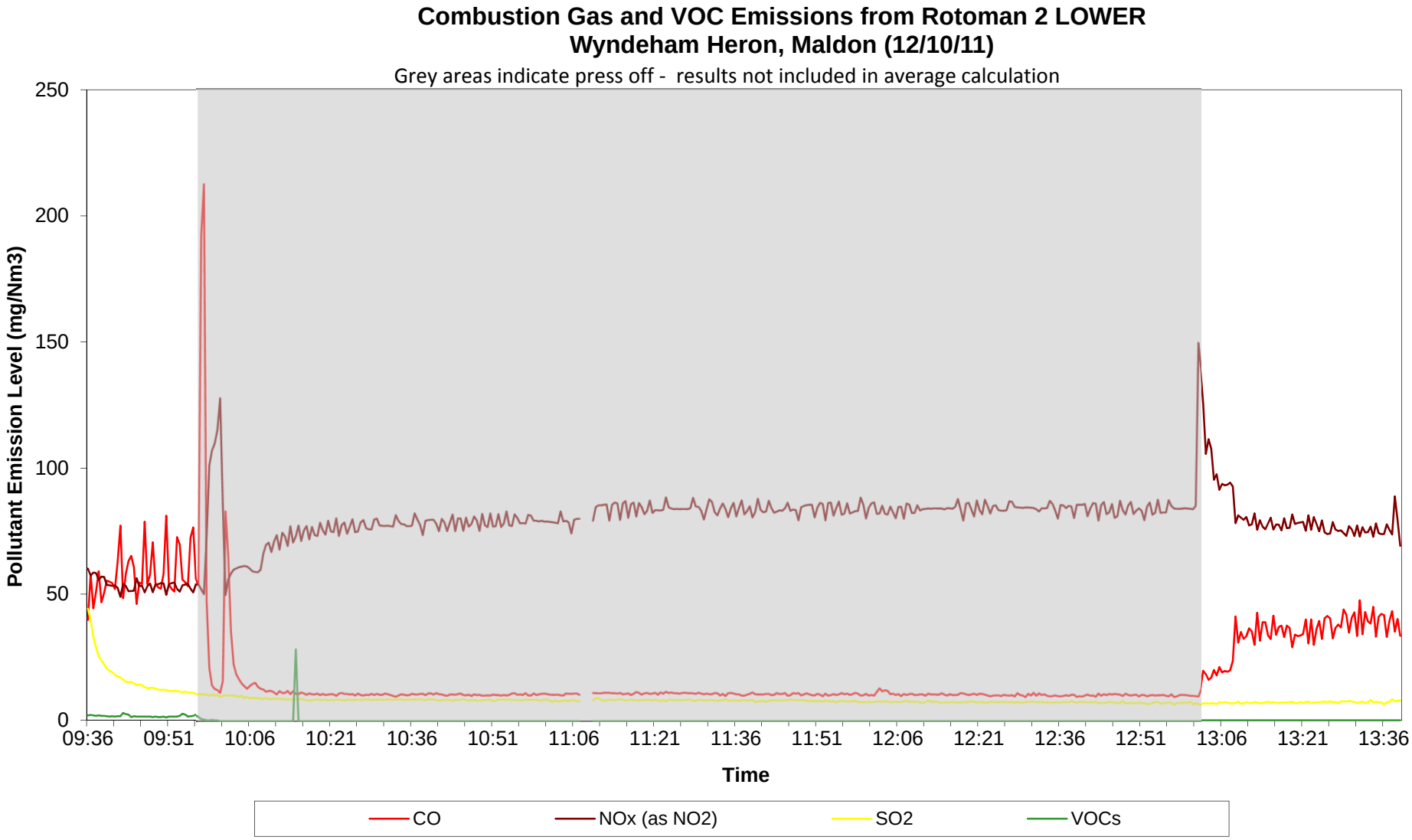
Signal Analyser: SIG1

Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	80.1	ppm +/-2%	49.3	ppm +/-2%	151.9	ppm +/-2%	8.10	ppm +/-2%
Period								
Span PreCal direct to analyser	80.4	ppm	49.5	ppm	152.7	ppm	7.95.	ppm
Zero PreCal through sample line	-0.3	ppm	0.0	ppm	1.7	ppm	0.0	ppm
Span PreCal through sample line	79.1	ppm	49.2	ppm	150.1	ppm	8.7	ppm
Zero PostCal through sample line	0.2	ppm	0.5	ppm	-0.2	ppm	-0.9	ppm
Span PostCal through sample line	80.6	ppm	49.0	ppm	147.6	ppm	7.9	ppm
Span Drift	-1.8	%	0.5	%	1.6	%		
Zero Drift	-0.5	%	-1.0	%	1.3	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

2.5.7 Instrumental gas analyser results

Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers
Wyndeham Heron, Maldon
Combustion Gas and VOC Emissions from Rotoman 2 LOWER (12/10/11)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm³ WET			
					CO (mg/Nm³)	NOx (as NO_2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	**37.6**	**33.6**	**4.0**	**0.4**	**45.5**	**67.6**	**11.0**	**0.7**
Maximum	**69.2**	**43.3**	**16.5**	**1.8**	**81.1**	**88.8**	**44.3**	**2.9**
Minimum	**23.2**	**25.4**	**2.2**	**0.0**	**29.0**	**48.9**	**6.4**	**0.0**


Combustion Gas and VOC Emissions from Rotoman 2 LOWER
Wyndeham Heron, Maldon (12/10/11)
Grey areas indicate press off - results not included in average calculation
Pollutant Emission Level (mg/Nm3)
250
200
150
100
50
0
09:36
09:51
10:06
10:21
10:36
10:51
11:06
11:21
11:36
11:51
12:06
12:21
12:36
12:51
13:06
13:21
13:36
Time
CO
NOx (as NO2)
SO2
VOCs

2.5.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	37.65	ppm
Span Gas Certified Value =	80.1	ppm +/-2%
Emission Limit Value	100	mg/Nm³

Parameter	criteria	U	U^2
Repeatability	1% of value	0.3765	0.1417
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	0.7530	0.5669
Linearity	0.76% of value	0.2861	0.0819
Setting Gas Divider	0.25% of value	0.0941	0.0089
Interference	2.9% of value	1.0918	1.1920
Span Gas	1% of span gas	0.8010	0.6416
		Sum U^2	2.88
		Combined Standard Uncertainty (ppm]	1.70
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.33
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	8.8
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	4.16
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.2

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	33.62	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm³

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.3362	0.1130
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.6387	0.4080
Linearity	0.49% of value	0.1647	0.0271
Setting Gas Divider	0.25% of value	0.0840	0.0071
Interference	1.2% of value	0.4034	0.1627
Span Gas	1% of span gas	0.4930	0.2430
		Sum U^2	1.05
		Combined Standard Uncertainty (ppm)	1.03
		Expanded Total Uncertainty (ppm) (95% Confidence)	2.01
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	6.0
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	4.12
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.1

UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =	3.987179496	ppm
Span Gas Certified Value =	151.9	ppm

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0399	0.0016
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0758	0.0057
Linearity	1.53% of value	0.0610	0.0037
Setting Gas Divider	0.25% of value	0.0100	0.0001
Interference	1.2% of value	0.0478	0.0023
Span Gas	1% of span gas	1.5190	2.3074
		Sum U^2	2.41
		Combined Standard Uncertainty (ppm)	1.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.04
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	76.3
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	8.70

UNCERTAINTY OF VOC BY SIGNAL 1

Reading =	0.42	ppm as C3H8
Span Gas=	8.10	ppm+/-2%
Emission Limit Value	20	mg/Nm³ as carbon

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0042	0.0000
Zero Drift/ Detection threshold	0.3ppm	0.3000	0.0900
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.5% of value	0.0042	0.0000
Setting Gas Divider	0.25% of value	0.0011	0.0000
Temperature Drift	1% of value	0.0042	0.0000
Span Gas	1% of Value	0.0810	0.0066
		Sum U^2	0.11
		Combined Standard Uncertainty (ppm as C3H8]	0.33
		Expanded Total Uncertainty (ppm as C3H8] (95% Confidence)	0.64
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	151.3
		Expanded Total Uncertainty (mg/Nm^3 as carbon) (95% Confidence)	1.03
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.1

2.6 Appendix 6: Rotoman 2 Upper Results and Calculations

2.6.1 Photograph of the sampling location and positions

2.6.2 Flow criteria measurements

Rotoman 2 Upper

Pitot Coefficient:	**0.847**	
Duct dimensions:	**50.0**	**cm**
Barometric pressure:	**1001**	**mbar**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s) Uncorrd.	Velocity (m/s) Corrd.	Temp (°C)
Single	A1	0.05	2.5	6.6	8.2	353
	A2	0.15	7.5	5.4	6.7	353
	A3	0.25	12.5	5.2	6.5	353
	A4	0.35	17.5	5.0	6.2	353
	A5	0.45	22.5	5.3	6.6	353
	A6	0.55	27.5	4.5	5.6	353
	A7	0.65	32.5	5.0	6.2	353
	A8	0.75	37.5	6.2	7.7	353
	A9	0.85	42.5	5.8	7.2	353
	A10	0.95	47.5	5.7	7.1	353

Velocity readings (m/s)

Duct Mean m/s	**6.8**		
Highest(a)	8.2	Lowest (b)	5.6

Temperature readings

Duct Mean °C	**353**		
Duct Mean K		626	
Highest(a)	353.0	Lowest (b)	353.0

Volumetic flow rate

Duct dimensions	50.0	(cm)
Duct area	0.196	(m^2)
Mean duct velocity	6.8	(m/s)
Mean duct temperature	353	(^oC)
Ambient pressure	1001	(mbar)
Vol. Flow rate at stack conditions	**4818**	**(m^3/hr)**
Vol flow rate corrd.	**2076.0**	**(Nm^3/hr)**

2.6.3 Water vapour measurements

Stack Reference:	Rotoman 2 Upper		
Ambient Pressure (mbar):	1001	**Gasmeter Coefficient:**	1.0000
Equipment used:	SKC Sidepak	**Mean Gasmeter Temp. (°C):**	33

End Flowrate Reading (l/min)	1.558
Start Flowrate Reading (l/min)	1.618
Volume Sampled (l)	31.8
Corrected Volume Sampled (l)	28.0

End Time	14:35:00
Start Time	14:15:00
Total Time mins	20.00

	IMPINGER	
	1	**2**
End Weight of Impingers (g)	94.3	98.1
Start Weight of Impingers (g)	92.8	97.4
Weight Gain (g)	1.5	0.7

Total Weight Gain (1+2+3+4) (g	2.2
Total Weight Gain in litres (l)	2.74

Moisture Content of Gases (%)	**8.91**

2.6.4 Manual monitoring method - results – calculations
Not applicable

2.6.5 Analysis results
Not applicable

2.6.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 2 UPPER (12/10/11)

Data entered by: CM

Horiba Analyser: Horiba 1

Signal Analyser: SIG1

Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	80.1	ppm +/-2%	49.3	ppm +/-2%	151.9	ppm +/-2%	8.10	ppm +/-2%
Period								
Span PreCal direct to analyser	80.4	ppm	49.5	ppm	152.7	ppm	7.95.	ppm
Zero PreCal through sample line	-0.3	ppm	0.0	ppm	1.7	ppm	0.0	ppm
Span PreCal through sample line	79.1	ppm	49.2	ppm	150.1	ppm	8.7	ppm
Zero PostCal through sample line	0.2	ppm	0.5	ppm	-0.2	ppm	-0.9	ppm
Span PostCal through sample line	80.6	ppm	49.0	ppm	147.6	ppm	7.9	ppm
Span Drift	-1.8	%	0.5	%	1.6	%		
Zero Drift	-0.5	%	-1.0	%	1.3	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

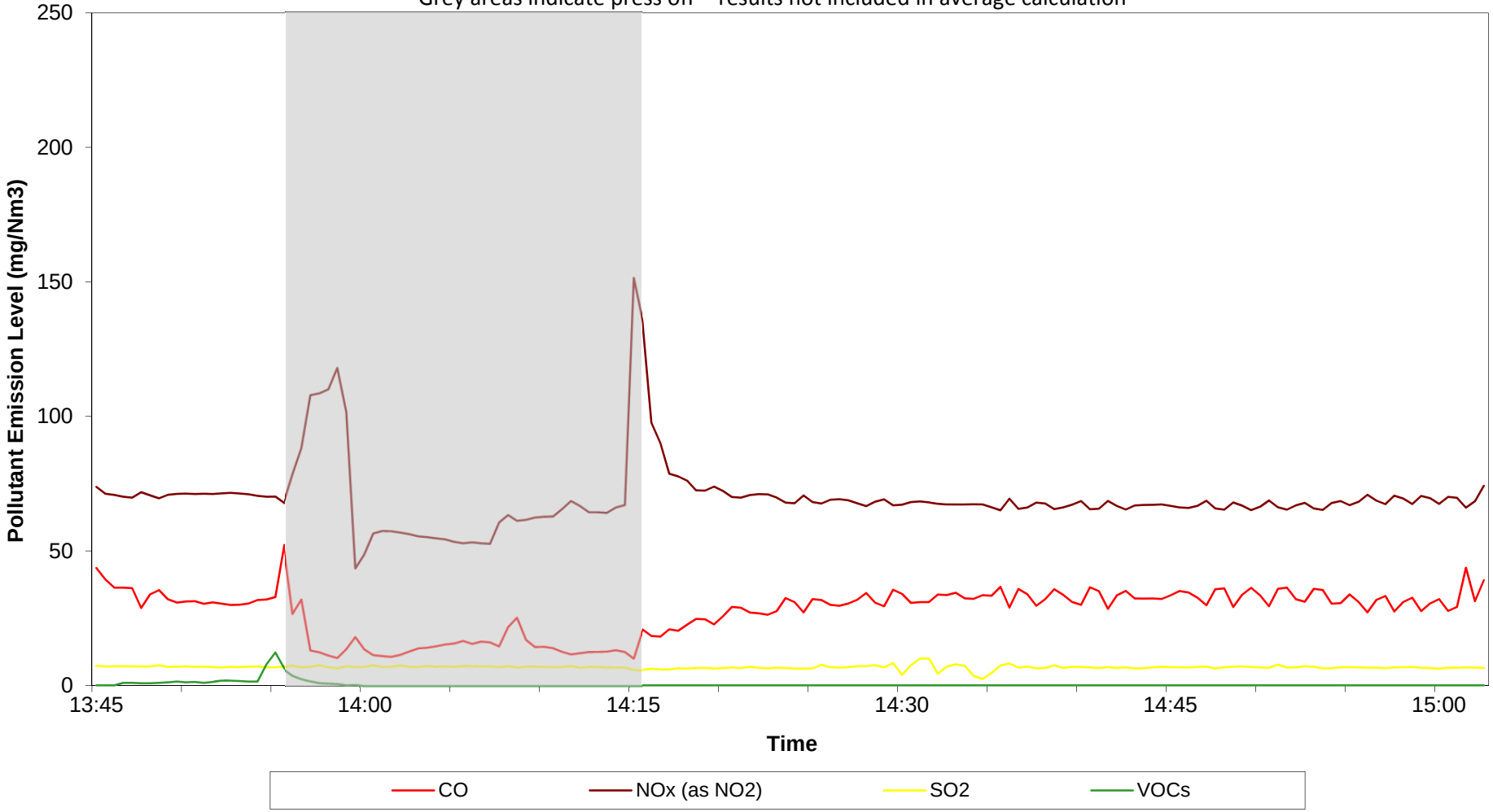
2.6.7 Instrumental gas analyser results

Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers
Wyndeham Heron, Maldon
Combustion Gas and VOC Emissions from Rotoman 2 UPPER (12/10/11)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm³			
					CO (mg/Nm³)	NOx (as NO_2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	**27.7**	**37.4**	**2.6**	**0.3**	**31.6**	**70.0**	**6.7**	**0.4**
Maximum	**45.8**	**72.4**	**3.8**	**7.6**	**52.2**	**135.3**	**10.0**	**12.2**
Minimum	**15.9**	**34.8**	**0.9**	**0.0**	**18.1**	**65.1**	**2.4**	**0.0**

Combustion Gas and VOC Emissions from Rotoman 2 UPPER
Wyndeham Heron, Maldon (12/10/11)

Grey areas indicate press off - results not included in average calculation



2.6.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	27.72	ppm
Span Gas Certified Value =	80.1	ppm +/-2%
Emission Limit Value	100	mg/Nm³

Parameter	criteria	U	U^2
Repeatability	1% of value	0.2772	0.0768
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	0.5544	0.3074
Linearity	0.76% of value	0.2107	0.0444
Setting Gas Divider	0.25% of value	0.0693	0.0048
Interference	2.9% of value	0.8039	0.6462
Span Gas	1% of span gas	0.8010	0.6416
		Sum U^2	1.97
		Combined Standard Uncertainty (ppm]	1.40
		Expanded Total Uncertainty (ppm) (95% Confidence)	2.75
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	9.9
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	3.44
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	3.4

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	37.45	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm³

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.3745	0.1402
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.7115	0.5063
Linearity	0.49% of value	0.1835	0.0337
Setting Gas Divider	0.25% of value	0.0936	0.0088
Interference	1.2% of value	0.4494	0.2020
Span Gas	1% of span gas	0.4930	0.2430
		Sum U^2	1.22
		Combined Standard Uncertainty (ppm)	1.11
		Expanded Total Uncertainty (ppm) (95% Confidence)	2.17
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	5.8
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	4.45
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.5

UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =	2.578151255	ppm
Span Gas Certified Value =	151.9	ppm

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0258	0.0007
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0490	0.0024
Linearity	1.53% of value	0.0394	0.0016
Setting Gas Divider	0.25% of value	0.0064	0.0000
Interference	1.2% of value	0.0309	0.0010
Span Gas	1% of span gas	1.5190	2.3074
		Sum U^2	2.40
		Combined Standard Uncertainty (ppm)	1.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.04
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	117.8
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	8.68

UNCERTAINTY OF VOC BY SIGNAL 1

Reading =	0.27	ppm as C3H8
Span Gas=	8.10	ppm+/-2%
Emission Limit Value	20	mg/Nm³ as carbon

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0027	0.0000
Zero Drift/ Detection threshold	0.3ppm	0.3000	0.0900
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.5% of value	0.0027	0.0000
Setting Gas Divider	0.25% of value	0.0007	0.0000
Temperature Drift	1% of value	0.0027	0.0000
Span Gas	1% of Value	0.0810	0.0066
		Sum U^2	0.11
		Combined Standard Uncertainty (ppm as C3H8]	0.33
		Expanded Total Uncertainty (ppm as C3H8] (95% Confidence)	0.64
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	232.9
		Expanded Total Uncertainty (mg/Nm^3 as carbon) (95% Confidence)	1.03
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.1

2.7 Appendix 7: Rotoman 3 Lower Results and Calculations

2.7.1 Photograph of the sampling location and positions

2.7.2 Flow criteria measurements

Rotoman 3 Lower

Pitot Coefficient:	**0.847**	
Duct dimensions:	**50.0**	**cm**
Barometric pressure:	**1001**	**mbar**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorrd.	Corrd.	
Single	A1	0.05	2.5	7.9	9.9	359
	A2	0.15	7.5	7.9	9.9	359
	A3	0.25	12.5	7.0	8.8	359
	A4	0.35	17.5	8.0	10.0	359
	A5	0.45	22.5	7.7	9.6	359
	A6	0.55	27.5	7.5	9.4	359
	A7	0.65	32.5	8.2	10.3	359
	A8	0.75	37.5	8.5	10.6	359
	A9	0.85	42.5	8.6	10.8	359
	A10	0.95	47.5	7.8	9.8	359

Velocity readings (m/s)

Duct Mean m/s	**9.9**			
Highest(a)	10.8	Lowest (b)	8.8	

Temperature readings

Duct Mean °C	**359**		
Duct Mean K		632	
Highest(a)	359.0	Lowest (b)	359.0

Volumetic flow rate

Duct dimensions	50.0	(cm)
Duct area	0.196	(m^2)
Mean duct velocity	9.9	(m/s)
Mean duct temperature	359	(^oC)
Ambient pressure	1001	(mbar)
Vol. Flow rate at stack conditions	**7000**	**(m^3/hr)**
Vol flow rate corrd.	**2987.8**	**(Nm^3/hr)**

2.7.3 Water vapour measurements

Stack Reference:	Rotoman 3 Lower		
Ambient Pressure (mbar):	1001	**Gasmeter Coefficient:**	1.0000
Equipment used:	SKC Sidepak	**Mean Gasmeter Temp. (°C):**	35

End Flowrate Reading (l/min)	0.71
Start Flowrate Reading (l/min)	0.709
Volume Sampled (l)	14.2
Corrected Volume Sampled (l)	12.4

End Time	16:35:00
Start Time	16:15:00
Total Time mins	20.00

	IMPINGER	
	1	**2**
End Weight of Impingers (g)	95.4	100.1
Start Weight of Impingers (g)	95.0	100
Weight Gain (g)	0.4	0.1

Total Weight Gain (1+2+3+4) (g	0.5
Total Weight Gain in litres (l)	0.62

Moisture Content of Gases (%)	**4.77**

2.7.4 Manual monitoring method - results – calculations
Not applicable

2.7.5 Analysis results
Not applicable

2.7.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 3 LOWER (12/10/11)

Data entered by: CM

Horiba Analyser: Horiba 1

Signal Analyser: SIG1

Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	80.1	ppm +/-2%	49.3	ppm +/-2%	151.9	ppm +/-2%	8.10	ppm +/-2%
Period								
Span PreCal direct to analyser	80.4	ppm	49.5	ppm	152.7	ppm	7.95.	ppm
Zero PreCal through sample line	-0.3	ppm	0.0	ppm	1.7	ppm	0.0	ppm
Span PreCal through sample line	79.1	ppm	49.2	ppm	150.1	ppm	8.7	ppm
Zero PostCal through sample line	0.2	ppm	0.5	ppm	-0.2	ppm	-0.9	ppm
Span PostCal through sample line	80.6	ppm	49.0	ppm	147.6	ppm	7.9	ppm
Span Drift	-1.8	%	0.5	%	1.6	%		
Zero Drift	-0.5	%	-1.0	%	1.3	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

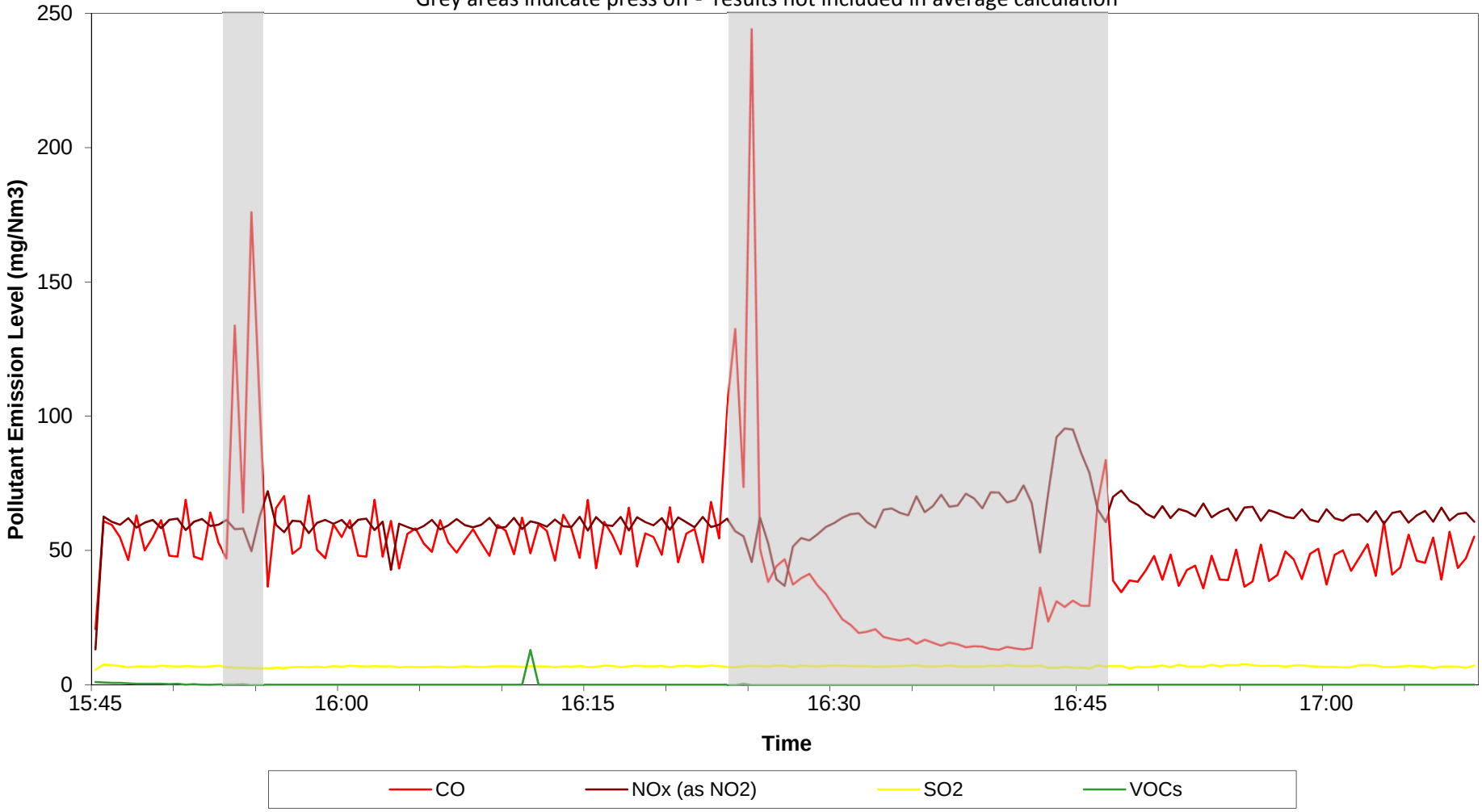
2.7.7 Instrumental gas analyser results

Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers
Wyndeham Heron, Maldon
Combustion Gas and VOC Emissions from Rotoman 3 Lower (12/10/11)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm³ WET			
					CO (mg/Nm³)	NOx (as NO_2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	**42.3**	**31.8**	**2.5**	**0.1**	**50.4**	**62.2**	**6.8**	**0.1**
Maximum	**86.1**	**48.8**	**2.8**	**8.0**	**102.5**	**95.4**	**7.6**	**12.9**
Minimum	**17.4**	**6.7**	**2.0**	**0.0**	**20.7**	**13.1**	**5.6**	**0.0**

Combustion Gas and VOC Emissions from Rotoman 3 LOWER Wyndeham Heron, Maldon (12/10/11)

Grey areas indicate press off - results not included in average calculation



2.7.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	42.29	ppm
Span Gas Certified Value =	80.1	ppm +/-2%
Emission Limit Value	100	mg/Nm³

Parameter	criteria	U	U^2
Repeatability	1% of value	0.4229	0.1789
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	0.8459	0.7155
Linearity	0.76% of value	0.3214	0.1033
Setting Gas Divider	0.25% of value	0.1057	0.0112
Interference	2.9% of value	1.2265	1.5044
Span Gas	1% of span gas	0.8010	0.6416
		Sum U^2	3.40
		Combined Standard Uncertainty (ppm]	1.85
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.62
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	8.6
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	4.52
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.5

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	31.80	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm³

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.3180	0.1011
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.6042	0.3650
Linearity	0.49% of value	0.1558	0.0243
Setting Gas Divider	0.25% of value	0.0795	0.0063
Interference	1.2% of value	0.3816	0.1456
Span Gas	1% of span gas	0.4930	0.2430
		Sum U^2	0.98
		Combined Standard Uncertainty (ppm)	0.99
		Expanded Total Uncertainty (ppm) (95% Confidence)	1.94
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	6.1
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	3.97
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.0

UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =	2.484244796	ppm
Span Gas Certified Value =	151.9	ppm

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0248	0.0006
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0472	0.0022
Linearity	1.53% of value	0.0380	0.0014
Setting Gas Divider	0.25% of value	0.0062	0.0000
Interference	1.2% of value	0.0298	0.0009
Span Gas	1% of span gas	1.5190	2.3074
		Sum U^2	2.40
		Combined Standard Uncertainty (ppm)	1.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.04
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	122.3
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	8.68

UNCERTAINTY OF VOC BY SIGNAL 1

Reading =	0.09	ppm as C3H8
Span Gas=	8.10	ppm+/-2%
Emission Limit Value	20	mg/Nm³ as carbon

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0009	0.0000
Zero Drift/ Detection threshold	0.3ppm	0.3000	0.0900
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.5% of value	0.0009	0.0000
Setting Gas Divider	0.25% of value	0.0002	0.0000
Temperature Drift	1% of value	0.0009	0.0000
Span Gas	1% of Value	0.0810	0.0066
		Sum U^2	0.11
		Combined Standard Uncertainty (ppm as C3H8]	0.33
		Expanded Total Uncertainty (ppm as C3H8] (95% Confidence)	0.64
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	712.2
		Expanded Total Uncertainty (mg/Nm^3 as carbon) (95% Confidence)	1.03
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.1

2.8 Appendix 8: Rotoman 3 Upper Results and Calculations

2.8.1 Photograph of the sampling location and positions

2.8.2 Flow criteria measurements

Rotoman 3 Upper

Pitot Coefficient:	**0.847**	
Duct dimensions:	**50.0**	**cm**
Barometric pressure:	**1001**	**mbar**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s) Uncorrd.	Velocity (m/s) Corrd.	Temp (°C)
Single	A1	0.05	2.5	7.2	9.0	364
	A2	0.15	7.5	10.8	13.6	364
	A3	0.25	12.5	9.6	12.1	364
	A4	0.35	17.5	9.5	11.9	364
	A5	0.45	22.5	8.9	11.2	364
	A6	0.55	27.5	9.1	11.4	364
	A7	0.65	32.5	9.1	11.4	364
	A8	0.75	37.5	9.6	12.1	364
	A9	0.85	42.5	9.5	11.9	364
	A10	0.95	47.5	9.6	12.1	364

Velocity readings (m/s)

Duct Mean m/s	**11.7**			
Highest(a)	13.6		Lowest (b)	9.0

Temperature readings

Duct Mean °C	**364**			
Duct Mean K			637	
Highest(a)	364.0		Lowest (b)	364.0

Volumetic flow rate

Duct dimensions	50.0	(cm)
Duct area	0.196	(m^2)
Mean duct velocity	11.7	(m/s)
Mean duct temperature	364	(^oC)
Ambient pressure	1001	(mbar)
Vol. Flow rate at stack conditions	**8253**	**(m^3/hr)**
Vol flow rate corrd.	**3495.3**	**(Nm^3/hr)**

2.8.3 Water vapour measurements

Stack Reference:	Rotoman 3 Upper		
Ambient Pressure (mbar):	1001	**Gasmeter Coefficient:**	1.0000
Equipment used:	SKC Sidepak	**Mean Gasmeter Temp. (°C):**	35

End Flowrate Reading (l/min)	0.657
Start Flowrate Reading (l/min)	0.474
Volume Sampled (l)	17.0
Corrected Volume Sampled (l)	14.9

End Time	18:25:00
Start Time	17:55:00
Total Time mins	30.00

	IMPINGER	
	1	**2**
End Weight of Impingers (g)	97.0	97.5
Start Weight of Impingers (g)	96.3	97.7
Weight Gain (g)	0.7	-0.2

Total Weight Gain (1+2+3+4) (g	0.5
Total Weight Gain in litres (l)	0.62

Moisture Content of Gases (%)	**4.02**

2.8.4 Manual monitoring method - results – calculations
Not applicable

2.8.5 Analysis results
Not applicable

2.8.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 3 UPPER (12/10/11)

Data entered by: CM

Horiba Analyser: Horiba 1

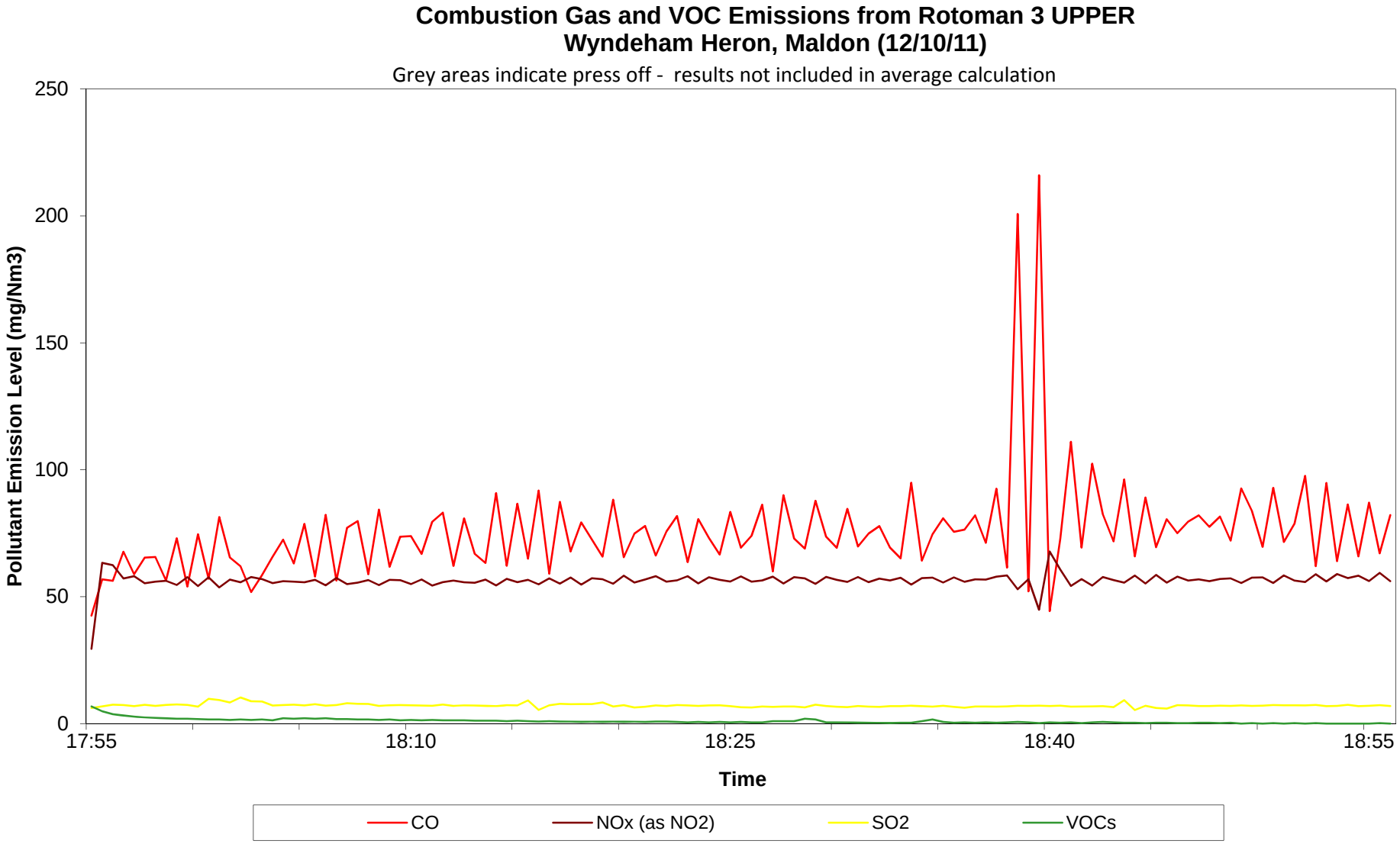
Signal Analyser: SIG1

Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	80.1	ppm +/-2%	49.3	ppm +/-2%	151.9	ppm +/-2%	8.10	ppm +/-2%
Period								
Span PreCal direct to analyser	80.4	ppm	49.5	ppm	152.7	ppm	7.95.	ppm
Zero PreCal through sample line	-0.3	ppm	0.0	ppm	1.7	ppm	0.0	ppm
Span PreCal through sample line	79.1	ppm	49.2	ppm	150.1	ppm	8.7	ppm
Zero PostCal through sample line	0.2	ppm	0.5	ppm	-0.2	ppm	-0.9	ppm
Span PostCal through sample line	80.6	ppm	49.0	ppm	147.6	ppm	7.9	ppm
Span Drift	-1.8	%	0.5	%	1.6	%		
Zero Drift	-0.5	%	-1.0	%	1.3	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

2.8.7 Instrumental gas analyser results

Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers
Wyndeham Heron, Maldon
Combustion Gas and VOC Emissions from Rotoman 3 UPPER (12/10/11)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm³ WET			
					CO (mg/Nm³)	NOx (as NO_2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	**63.1**	**28.6**	**2.6**	**0.6**	**75.7**	**56.4**	**7.1**	**1.0**
Maximum	**180.0**	**34.4**	**3.8**	**4.2**	**216.0**	**67.8**	**10.3**	**6.8**
Minimum	**35.5**	**14.9**	**2.0**	**0.0**	**42.5**	**29.4**	**5.3**	**0.0**


Combustion Gas and VOC Emissions from Rotoman 3 UPPER
Wyndeham Heron, Maldon (12/10/11)
Grey areas indicate press off - results not included in average calculation
Pollutant Emission Level (mg/Nm3)
250
200
150
100
50
0
17:55
18:10
18:25
18:40
18:55
Time
CO
NOx (as NO2)
SO2
VOCs

2.8.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	63.12	ppm
Span Gas Certified Value =	80.1	ppm +/-2%
Emission Limit Value	100	mg/Nm³

Parameter	criteria	U	U^2
Repeatability	1% of value	0.6312	0.3984
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	1.2624	1.5938
Linearity	0.76% of value	0.4797	0.2301
Setting Gas Divider	0.25% of value	0.1578	0.0249
Interference	2.9% of value	1.8306	3.3509
Span Gas	1% of span gas	0.8010	0.6416
		Sum U^2	6.49
		Combined Standard Uncertainty (ppm]	2.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	4.99
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	7.9
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	6.24
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	6.2

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	28.61	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm³

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.2861	0.0818
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.5435	0.2954
Linearity	0.49% of value	0.1402	0.0196
Setting Gas Divider	0.25% of value	0.0715	0.0051
Interference	1.2% of value	0.3433	0.1178
Span Gas	1% of span gas	0.4930	0.2430
		Sum U^2	0.85
		Combined Standard Uncertainty (ppm)	0.92
		Expanded Total Uncertainty (ppm) (95% Confidence)	1.81
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	6.3
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	3.72
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	3.7

UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =	2.599999998	ppm
Span Gas Certified Value =	151.9	ppm

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0260	0.0007
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0494	0.0024
Linearity	1.53% of value	0.0398	0.0016
Setting Gas Divider	0.25% of value	0.0065	0.0000
Interference	1.2% of value	0.0312	0.0010
Span Gas	1% of span gas	1.5190	2.3074
		Sum U^2	2.40
		Combined Standard Uncertainty (ppm)	1.55
		Expanded Total Uncertainty (ppm) (95% Confidence)	3.04
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	116.9
		Expanded Total Uncertainty (mg/Nm^3) (95% Confidence)	8.69

UNCERTAINTY OF VOC BY SIGNAL 1

Reading =	0.60	ppm as C3H8
Span Gas=	8.10	ppm+/-2%
Emission Limit Value	20	mg/Nm³ as carbon

Parameter	Uncertainty criteria	U	U^2
Repeatability	1% of value	0.0060	0.0000
Zero Drift/ Detection threshold	0.3ppm	0.3000	0.0900
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.5% of value	0.0060	0.0000
Setting Gas Divider	0.25% of value	0.0015	0.0000
Temperature Drift	1% of value	0.0060	0.0000
Span Gas	1% of Value	0.0810	0.0066
		Sum U^2	0.11
		Combined Standard Uncertainty (ppm as C3H8]	0.33
		Expanded Total Uncertainty (ppm as C3H8] (95% Confidence)	0.64
		Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	107.1
		Expanded Total Uncertainty (mg/Nm^3 as carbon) (95% Confidence)	1.03
		Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	5.1

2.9 Appendix 9: Compactor Upper Results and Calculations

2.9.1 Photograph of the sampling location and positions

2.9.2 Flow criteria measurements

Not applicable

2.9.3 Water vapour measurements

Not applicable.

2.9.4 Analysis results

Not applicable.

2.9.5 Instrumental gas analyser site calibration measurements

Not applicable.

2.9.6 Instrumental gas analyser results

Not applicable.

2.9.7 Manual monitoring method - results – calculations

Site: **Wyndeham Heron** Duct: **Compactor**
Atmospheric Press: 1015 mbar

PARTICULATE MONITORING (MDHS-14)

	Duct Reference	Pump No.	Filter No.	Flow Checks Start (l/min)	Flow Checks Finish (l/min)	Average Flow (l/min)	Time ON (hr:m:s)	Time OFF (hr:m:s)	Elapsed Time (hr:m:s)	Elapsed Time (min)	Air Volume Sampled (m^3)	Filter Masses Initial (mg)	Filter Masses Final (mg)	Filter Masses Difference (mg)	Concn. Partic. Matter (mg/m^3)	Corr. Part.Matt. Concn. (mg/Nm^3)	Air Temp. (°C)
1	Left Emission	21	**71**	2.00	2.00	2.00	10:35:00	13:54:00	03:19:00	199.00	0.39800	24.89	26.79	1.90	4.77	**4.442**	21
2	Left Emission	29	**R6**	2.00	2.00	2.00	10:35:00	13:54:00	03:19:00	199.00	0.39800	25.42	27.82	2.40	6.03	**5.610**	21
3	Left Emission	8	**R4**	2.00	2.00	2.00	10:35:00	13:54:00	03:19:00	199.00	0.39800	25.31	26.07	0.76	1.91	**1.777**	21
10	Control Filter	-	**3M**									24.96	24.75	-0.21			
															Average	**4.44**	

2.9.8 Uncertainty calculations

Not applicable