



# Envirocare

CONSULTANCY



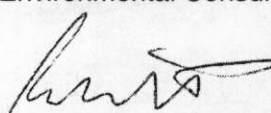
Caring for the environment and creating safer workplaces

## Report for the Periodic Monitoring of Emissions to Atmosphere

### Wyndeham Heron

Operator:	Wyndeham Heron
Permit Number:	Unknown
Installation:	Printworks
Monitoring Dates:	16-18 August 2010
Site Address:	The Bethnal Complex Colchester Road Maldon Essex

Report Number:	J 4377
Version:	1
Date of Report:	26 August 2010
Report Written by:	Mr M Ropka
MCERTS Registration N°:	MM 06 761
MCERTS Level:	Level 2 (TE1, TE3 & TE4)

Report Approved by:	Mr A Davis
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MCERTS Level:	MCERTS Level 2 (TE1, TE3, TE4)
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Signed:	

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## Part 1: Executive Summary

### 1.1 Monitoring Objectives

Wyndeham Heron operate several printing process lines that have the potential to release controlled substances to atmosphere, and are subject to authorisation under the Environmental Protection Act 1990 (EPA). Under the act, Local Authorities regulate the printing processes with guidance from the Process Guidance Note PG6/16(04): Printworks.

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 two Lithomans, each have a dedicated dryer.

Emission Point Identification

Substances to Be Monitored	Rotoman 1		Rotoman 2		Rotoman 3		Lithoman 1	Lithoman 2	Compactor
	Lower	Upper	Lower	Upper	Lower	Upper			
CO	✓	✓	✓	✓	✓	✓	✓	✓	
NOx	✓	✓	✓	✓	✓	✓	✓	✓	
SO <sub>2</sub>	✓	✓	✓	✓	✓	✓	✓	✓	
VOCs	✓	✓	✓	✓	✓	✓	✓	✓	
Particulates									✓

### 1.2 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 1 Lower	Carbon Monoxide	100	89.2	7.0	mg/Nm <sup>3</sup>	273K, 101.3kPa	18/08/10	12:52-13:52	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO <sub>2</sub> )	100	41.0	3.4					BS EN 14792		
	Sulphur Dioxide	N/A	14.2	8.9					EA TGN M21		
	VOCs	20	9.9	0.8					BS EN 13526		
Rotoman 1 Upper	Carbon Monoxide	100	69.6	5.6	mg/Nm <sup>3</sup>	273K, 101.3kPa	18/08/10	16:15-17:15	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO <sub>2</sub> )	100	58.5	4.0					BS EN 14792		
	Sulphur Dioxide	N/A	14.0	8.9					EA TGN M21		
	VOCs	20	16.3	0.9					BS EN 13526		

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 2 Lower	Carbon Monoxide	100	25.5	3.0	mg/Nm <sup>3</sup>	273K, 101.3kPa	17/08/10	13:11-14:02	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO <sub>x</sub> )	100	86.3	6.3					BS EN 14792		
	Sulphur Dioxide	N/A	7.4	11.5					EA TGN M21		
	VOCs	20	0.0	1.4					BS EN 13526		
Rotoman 2 Upper	Carbon Monoxide	100	86.1	6.8	mg/Nm <sup>3</sup>	273K, 101.3kPa	17/08/10	14:50-15:36	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO <sub>x</sub> )	100	49.1	4.9					BS EN 14792		
	Sulphur Dioxide	N/A	7.4	11.5					EA TGN M21		
	VOCs	20	0.5	1.4					BS EN 13526		

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status				
Rotoman 3 Lower	Carbon Monoxide	100	75.9	6.1	mg/Nm <sup>3</sup>	273K, 101.3kPa	16/08/10	15:18-16:18	BS EN 15058	MCERTS	Normal				
	Oxides of Nitrogen (as NO <sub>2</sub> )	100	49.6	4.9					BS EN 14792						
	Sulphur Dioxide	N/A	3.6	11.5					EA TGN M21						
	VOCs	20	1.9	1.4					BS EN 13526						
Rotoman 3 Upper	Carbon Monoxide	100	59.4	5.0				mg/Nm <sup>3</sup>	273K, 101.3kPa			16:29-17:29	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO <sub>2</sub> )	100	65.3	5.5									BS EN 14792		
	Sulphur Dioxide	N/A	3.6	11.5									EA TGN M21		
	VOCs	20	1.9	1.4									BS EN 13526		

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Lithoman 1	Carbon Monoxide	100	70.9	5.8	mg/Nm <sup>3</sup>	273K, 101.3kPa	17/08/10	11:25-12:25	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO <sub>x</sub> )	100	51.0	3.8					BS EN 14792		
	Sulphur Dioxide	N/A	10.3	8.9					EA TGN M21		
	VOCs	20	1.7	0.8					BS EN 13526		
	Carbon Monoxide	100	717.5	53.8					BS EN 15058		
Lithoman 2	Oxides of Nitrogen (as NO <sub>x</sub> )	100	32.7	3.2	mg/Nm <sup>3</sup>	273K, 101.3kPa	16/08/10	17:57-18:37	BS EN 14792	MCERTS	Normal
	Sulphur Dioxide	N/A	14.7	8.9					EA TGN M21		
	VOCs	20	30.9	1.2					BS EN 13526		
Compactor	Particulates	N/A	1.9	N/A	mg/Nm <sup>3</sup>	273K, 101.3kPa	17/08/10	12:24-16:30	MDHS 14/3	None	Normal

### 1.3 Operating Information

Emission Point Reference	Date	Process Type	Process Duration	Fuel	Feedstock	Abatement	Load	Comparison of Operator CEMS and Periodic Monitoring Results		
								Substance	CEMS Results	Periodic Monitoring Results
Rotoman 1 Lower	18/08/10						30,000cph	N/A	N/A	N/A
Rotoman 1 Upper	18/08/10						30,000cph	N/A	N/A	N/A
Rotoman 2 Lower	17/08/10					MEGTEC Summit II	Unknown	N/A	N/A	N/A
Rotoman 2 Upper	17/08/10	Drying Unit	Continuous except for paper and press changes	Natural Gas	Ink		Unknown	N/A	N/A	N/A
Rotoman 3 Lower	16/08/10						Unknown	N/A	N/A	N/A
Rotoman 3 Upper	16/08/10						Unknown	N/A	N/A	N/A
Lithoman 1	17/08/10					MEGTEC DualDry DDTNV	60,000cph	N/A	N/A	N/A
Lithoman 2	16/08/10						Unknown	N/A	N/A	N/A
Compactor	17/08/10	Compactor	Continuous	N/A	Waste paper	Bag Filter	N/A	N/A	N/A	N/A

### 1.4 Monitoring Deviations

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
Rotoman 1 Lower	None	None	None
Rotoman 1 Upper	None	None	None
Rotoman 2 Lower	None	None	Flow traverse only carried out through 1 port due to access issues.
Rotoman 2 Upper	None	None	Flow traverse only carried out through 1 port due to access issues.
Rotoman 3 Lower	None	None	Flow traverse only carried out through 1 port due to access issues.
Rotoman 3 Upper	None	None	Flow traverse only carried out through 1 port due to access issues.
Lithoman 1	None	None	Only half a velocity traverse along 1 line carried out as hole too small.
Lithoman 2	None	None	Flow traverse only carried out through 1 port due to access issues.
Compactor	None	None	None

## Part 2: Supporting Information

### 2.1 Appendix 1: General Information

#### 2.1.1 Monitoring organisation staff details

Mr M Ropka	MCERTS Level 2 (TE1, TE3 & TE4)	MM 06 761
Mr D Fisher	MCERTS Level 1 (TE1)	MM 08 963

#### 2.1.2 Monitoring organisation method details

##### 2.1.2.1 Standard Reference Conditions

All pollutant concentrations measured have been expressed at standard reference conditions of 273K and 101.3 kPa. The temperatures and local barometric pressure are measured to correct the data, where necessary, to the reference conditions, and were measured as follows:

##### 2.1.2.2 Temperature

A 1.5mm diameter Type K thermocouple coupled to a digital display (Tenma) was used to measure the ambient temperature on the days of monitoring.

##### 2.1.2.3 Local Atmospheric Pressure

An aneroid barometer was used to measure this parameter at several times during the days of monitoring.

##### 2.1.2.4 Combustion Gases

Combustion gases were monitored using a Horiba Combustion Gas Analyser (Model PG250) which monitors the gaseous emissions by appropriate systems for the gases in question. Oxygen is assessed by a Zirconium cell; Carbon Monoxide, CO by NDIR (pneumatic), Oxides of Nitrogen, NO<sub>x</sub>, by chemiluminescence and Sulphur Dioxide, SO<sub>2</sub>, by NDIR. It has an internal pump to draw a sample of the gas through the analyser at a rate of approximately 0.6litres per minute.

When the instrument had warmed up (60 mins), each pollutant was zeroed by passing 100% N<sub>2</sub> directly to the analyser. The analyser was then calibrated for each target pollutant with an appropriate calibration gas. Nitrogen was then passed directly to analyser again to ensure no zero drift. Nitrogen was then passed through the whole sampling system to ensure there were no leaks in the system (an Oxygen reading of greater than 0.1% would indicate the presence of a leak). Each calibration gas was then passed down the entire system to ensure there is no loss or absorption of the target pollutants. The measured value must be within  $\pm 2\%$  of the calibration gas value. At the end of the test nitrogen was passed down the entire system to check the zero values and then each calibration gas was passed down to the system to check for drift. If the post-test calibration value is within 2% of the calibration gas value no action is required. If the obtained value is between 2-5% of the calibration gas value the drift must be compensated for. If the drift is greater than 5% the test is invalid.

The analyser was connected to a portable laptop computer running custom EDA 2000 data logging software, which enables the future processing of results. Readings were logged at 15-second intervals during calibration and 30-second intervals during monitoring periods.

The conversion of the logged data in ppm to mg/m<sup>3</sup> and correction to standard conditions (273K & 101.3 kPa) was subsequently carried out for each Table. The average, maximum, and minimum values over the whole monitoring period are displayed for each parameter.

The sample gases were drawn through a titanium probe, inserted into the stack and connected to a heated line (150°C) containing a heated PTFE filter. The heated line was, in turn, connected to a Testoterm Gas Preparation Unit, GPU (Model 339)/Signal 2020SM cooler which contained a Peltier Cooler to condition the gas by removing moisture from the sampled gas down to approximately 1%, to enable a dried gas stream to be presented to the analyser. A Tygon tube connected the output from the

GPU to the input connection of the Horiba analyser.

#### 2.1.2.5 Total VOCs to BS EN 13526

All emission were monitored for total VOC utilising a portable organic vapour analyser fitted with a flame ionisation detector (Signal 3030PM). Gases were fed into the analyser along a 5 or 15 metre heated line.

When the instrument had warmed up and stabilised, it was zeroed electronically by drawing sampled air over a catalyst to remove organic species, and (if required) adjusting the analyser to read 0.0 ppm. The "CAL" button on the analyser was then pressed to set the analyser to this value.

A certified span gas, traceable to National Standards, was then fed directly to the analyser through the SPAN port. If required the value displayed on the unit was adjusted to read the certified value. The "CAL" button was then pressed to set this value. The calibration gas was then sampled down the entire sampling system to ensure no leaks, absorption or loss of pollutant. It is required that the value obtained whilst sampling down the entire system is within  $\pm 2\%$  of the value obtained when sampling directly to the analyser.

At the end of the sampling period calibration gas was sampled down the entire system again to ensure the analyser hadn't drifted.

The gaseous emissions were sampled directly from the stack, using the sampling hole in each duct, through a stainless steel probe and along the PTFE lined heated sample line to the instrument. An integral-heated PTFE filter in the input to the instrument removes any fine particulate matter material present in the sample gas.

Data was collected by custom-designed Sigems data logging software (V1.8 or V1.0) at approximately 30-second intervals directly onto a laptop computer.

In all cases, the VOC level was measured as parts per million (ppm) of propane. The data obtained were then converted to express the concentration as  $\text{mg}/\text{Nm}^3$ , with respect to propane, and as carbon content.

#### 2.1.2.6 Particulates to MDHS 14/3

Ideally, particulate monitoring would follow the methodology described in BS EN 13284 or BS ISO 9096. However, due to the construction of the duct, specifically the absence of suitable place to locate a sampling plane, sampling of particulate matter from the waste paper compactor extract followed the requirements of MDHS 14.

Four 25mm glass fibre filters were attached to the wire mesh fastened across the duct face directly in the airstream. Each filter had been previously weighed. It was then inserted into a carrier head and attached to a sampling pump. The pump was calibrated at 2 litres per minute and then checked at the end of the test. On returning to base the filters were reweighed and the results inputted into the relevant spreadsheet in order to calculate the concentration of particulate and the mass emission rate.

#### 2.1.3 Monitoring organisation equipment check list references

Equipment ID	Model Number	Purpose
Horiba 1	Horiba PG250	Multi component gas analyser
Horiba 2	Horiba PG250	Multi component gas analyser
Sig 1	Signal 3030pm	Flame Ionisation Detector
Sig 3	Signal 3030pm	Flame Ionisation Detector
GPU2	Testo 339	Heated line controller and peltier cooler
GPU3	Signal 2020SM	Peltier Cooler

## 2.2 Appendix 2: Rotoman 1 Lower Results and Discussions

### 2.2.1 Photograph of the sampling location and positions



Equipment ID	Model Number	Purpose
101	101	101
102	102	102
103	103	103
104	104	104
105	105	105
106	106	106
107	107	107
108	108	108
109	109	109
110	110	110

## 2.2.2 Flow criteria measurements

### DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 1 Lower** Date: 18/08/2010  
 Duct dimensions: 60.0 cm  
 Local barometric pressure: 1005 mbar  
 Ambient Temperature: 25 °C  
 Pitot Coefficient = 0.997  
 Micromanometer Calibration = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Right	A1	0.05	3.0	11.3	16.6	360
	A2	0.15	9.0	11.6	17.0	360
	A3	0.25	15.0	11.1	16.3	360
	A4	0.35	21.0	11.3	16.6	360
	A5	0.45	27.0	10.8	15.8	360
	A6	0.55	33.0	10.4	15.2	360
	A7	0.65	39.0	10.3	15.1	360
	A8	0.75	45.0	10.0	14.7	360
	A9	0.85	51.0	9.0	13.2	360
	A10	0.95	57.0	8.4	12.3	360
Sample port (B)	Traverse point	Traverse position (D)	Distance (m)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Left	B1	0.05	3.0	10.8	15.8	360
	B2	0.15	9.0	10.9	16.0	360
	B3	0.25	15.0	11.0	16.1	360
	B4	0.35	21.0	11.1	16.3	360
	B5	0.45	27.0	11.3	16.6	360
	B6	0.55	33.0	11.4	16.7	360
	B7	0.65	39.0	11.6	17.0	360
	B8	0.75	45.0	10.2	15.0	360
	B9	0.85	51.0	7.5	11.0	360
	B10	0.95	57.0	7.2	10.6	360

Velocity readings (m/s)		A	B
Traverse Mean		15.3	15.1
Duct Mean m/s		<b>15.2</b>	
Highest(a)	17.0	Lowest (b)	10.6
Ratio (a/b)	1.6 :1		
Acceptable if ratio <3:1			

Temperature readings		A	B
Traverse Mean °C		360	360
Duct Mean °C		<b>360</b>	
Duct Mean K		633.0	
Lowest / Highest Value, K	633.0	633.0	633.0
Permitted Range (0.9T to 1.1T)K	569.7	696.3	

Volumetric flow rate			
Duct dimensions	60.0	(cm)	
Duct area	0.283	(m <sup>2</sup> )	
Mean duct velocity	15.2	(m/s)	
Mean duct temperature	360	(°C)	
Ambient pressure	1005	(mbar)	
Vol. Flow rate at stack conditions	<b>15462</b>	(m <sup>3</sup> /hr)	
Vol flow rate corrd.	<b>6615.7</b>	(Nm <sup>3</sup> /hr)	

## 2.2.3 Water vapour measurements

Not applicable.

## 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

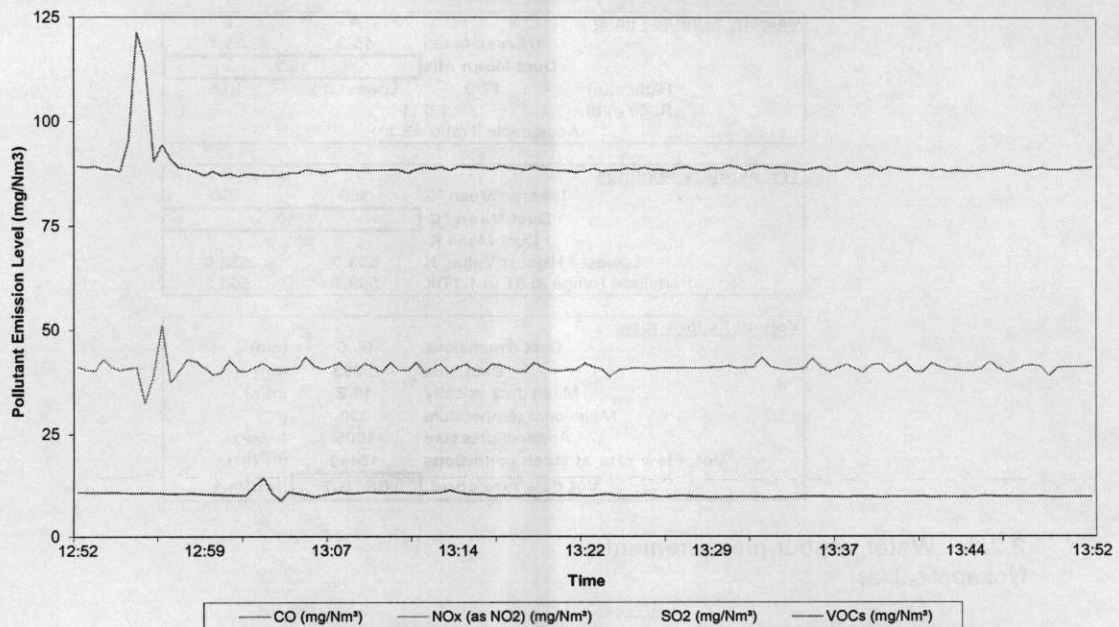
#### Combustion Gas and VOC Emissions from Rotoman 1 (18/08/10)

Data entered by: MR  
Horiba Analyser: Hor 1  
Signal Analyser: Sig 3

Type of Gas	CO		NO		SO2		VOCs	
Certified Calibration Values	79.7	ppm +/-2%	60.0	ppm +/-2%	152.9	ppm +/-2%	7.97	ppm +/-2%
Period								
Span PreCal direct to analyser	79.9	ppm	60.2	ppm	152.9	ppm	8.0	ppm
Zero PreCal through sample line	0.4	ppm	0.1	ppm	0.9	ppm	0.0	ppm
Span PreCal through sample line	79.4	ppm	60.0	ppm	152.9	ppm	8.2	ppm
Zero PostCal through sample line	1.1	ppm	0.1	ppm	0.7	ppm	-0.5	ppm
Span PostCal through sample line	75.7	ppm	60.0	ppm	145.9	ppm	7.8	ppm
Span Drift	4.6	%	0.0	%	4.6	%		
Zero Drift	-0.9	%	0.0	%	0.1	%		
Is data valid without adjustment	NO		YES		NO			
Does data require adjustment	YES		NO		YES			
Is data invalid	NO		NO		NO			

### 2.2.7 Instrumental gas analyser results

#### Combustion Gas and VOC Emissions from Rotoman 1 Lower Wyndeham Heron, Maldon (18/08/10)



#### Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers Wyndeham Heron, Maldon

#### Combustion Gas and VOC Emissions from Rotoman 1 Lower (18/08/10)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO <sub>2</sub> (ppm)	VOCs (ppm)	Results Adjusted for Span and Zero Drift				Conversion from ppm to mg/Nm <sup>3</sup>			
					CO (ppm)	NOx (ppm)	SO <sub>2</sub> (ppm)	VOCs (ppm)	CO (mg/Nm <sup>3</sup> )	NOx (as NO <sub>2</sub> ) (mg/Nm <sup>3</sup> )	SO <sub>2</sub> (mg/Nm <sup>3</sup> )	VOCs (mg/Nm <sup>3</sup> )
Average	69.8	20.0	4.0	6.2	71.3	20.0	5.0	6.2	89.2	41.0	14.2	9.9
Maximum	95.5	24.9	4.3	8.9	97.1	24.9	5.2	8.9	121.4	51.2	15.0	14.3
Minimum	68.2	15.8	3.8	5.4	69.5	15.8	4.7	5.4	86.9	32.4	13.4	8.6

### 2.2.8 Uncertainty calculations

#### UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =  ppm  
Span Gas Certified Value =  ppm +/-2%

Parameter	criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.6980	0.4872
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	1.3960	1.9488
Linearity	0.76% of value	0.5305	0.2814
Setting Gas Divider	0.25% of value	0.1745	0.0305
Interference	2.9% of value	2.0242	4.0974
Span Gas	1% of span gas	0.7970	0.6352

Sum U <sup>2</sup>	7.73
Total U	2.78 ppm
95% confidence	5.56 ppm
or	6.95 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.2000	0.0400
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.3800	0.1444
Linearity	0.49% of value	0.0980	0.0096
Setting Gas Divider	0.25% of value	0.0500	0.0025
Interference	1.2% of value	0.2400	0.0576
Span Gas	1% of span gas	0.6000	0.3600

Sum U <sup>2</sup>	0.70
Total U	0.84 ppm
95% confidence	1.68 ppm
or	3.44 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0400	0.0016
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0760	0.0058
Linearity	1.53% of value	0.0612	0.0037
Setting Gas Divider	0.25% of value	0.0100	0.0001
Interference	1.2% of value	0.0480	0.0023
Span Gas	1% of span gas	1.5290	2.3378

Sum U <sup>2</sup>	2.44
Total U	1.56 ppm
95% confidence	3.12 ppm
or	8.92 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF VOC BY SIGNAL3

Reading =  ppm as C3H8  
Span Gas =  ppm +/-2%

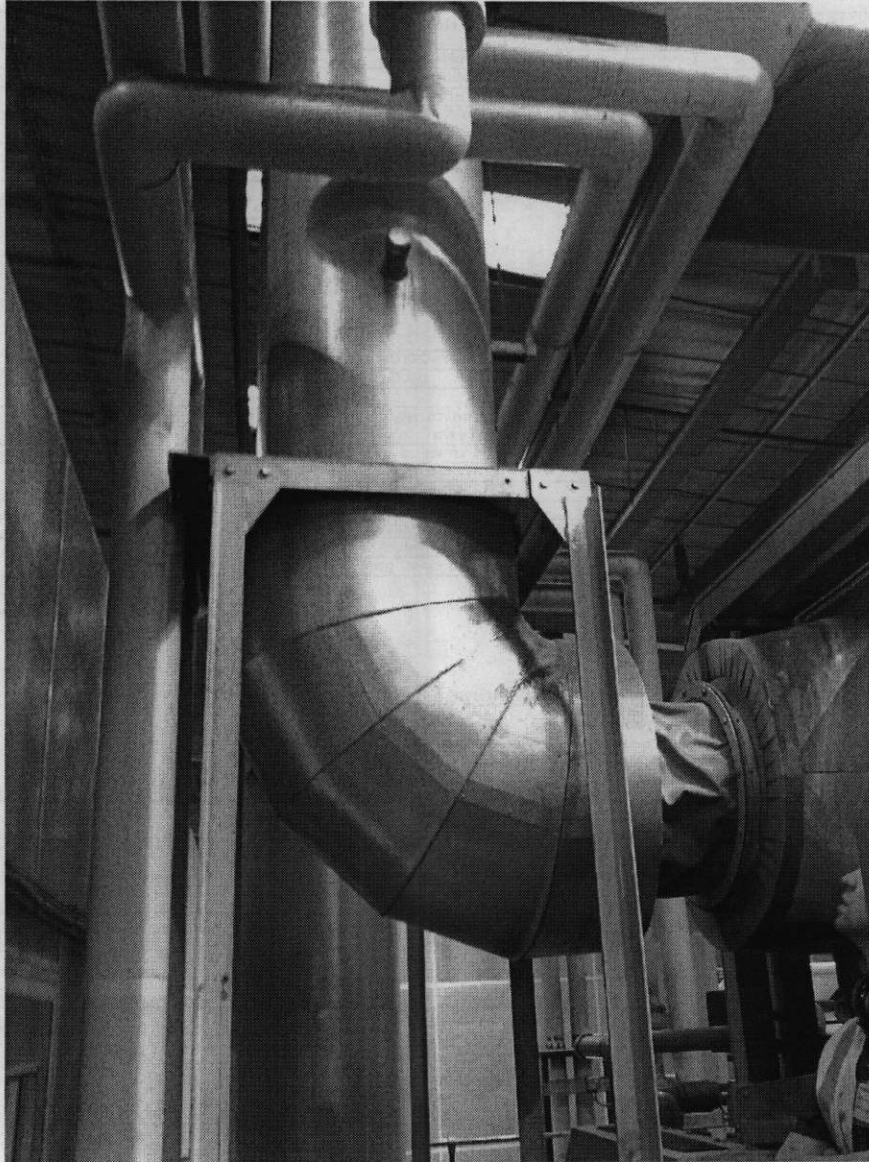
Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0620	0.0038
Zero Drift/ Detection threshold	0.2ppm	0.2000	0.0400
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.0372	0.0014
Setting Gas Divider	0.25% of value	0.0155	0.0002
Temperature Drift	1% of value	0.0620	0.0038
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.066
Total U	0.256 ppm
95% confidence	0.513 ppm as C3H8

or  mg/Nm<sup>3</sup> as carbon

## 2.3 Appendix 3: Rotoman 1 Upper Results and Discussions

### 2.3.1 Photograph of the sampling location and positions



### 2.3.2 Flow criteria measurements

**DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA**  
**Wyndeham Heron, Maldon**

Stack reference: **Rotoman 1 Upper** Date: 18/08/2010  
 Duct dimensions: 50.0 cm  
 Local barometric pressure: 1005 mbar  
 Ambient Temperature: 25 °C  
 Pitot Coefficient = 0.997  
 Micromanometer Calibration = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Right	A1	0.05	2.5	11.0	16.0	351
	A2	0.15	7.5	11.1	16.2	351
	A3	0.25	12.5	9.8	14.3	351
	A4	0.35	17.5	8.9	13.0	351
	A5	0.45	22.5	7.8	11.4	351
	A6	0.55	27.5	6.6	9.6	351
	A7	0.65	32.5	6.4	9.3	351
	A8	0.75	37.5	5.8	8.4	351
	A9	0.85	42.5	6.1	8.9	351
	A10	0.95	47.5	5.6	8.2	351
Sample port (B)	Traverse point	Traverse position (D)	Distance (m)	Velocity (m/s)		Temp (°C)
Left	B1	0.05	2.5	10.4	15.1	351
	B2	0.15	7.5	10.0	14.6	351
	B3	0.25	12.5	9.3	13.5	351
	B4	0.35	17.5	8.3	12.1	351
	B5	0.45	22.5	8.0	11.6	351
	B6	0.55	27.5	7.7	11.2	351
	B7	0.65	32.5	7.8	11.4	351
	B8	0.75	37.5	7.7	11.2	351
	B9	0.85	42.5	7.8	11.4	351
	B10	0.95	47.5	7.7	11.2	351

Velocity readings (m/s)		A	B
Traverse Mean		11.5	12.3
Duct Mean m/s		11.9	
Highest(a)	16.2	Lowest (b)	8.2
Ratio (a/b)	2.0 : 1		
Acceptable if ratio <3:1			

Temperature readings		A	B
Traverse Mean °C		351	351
Duct Mean °C		351	
Duct Mean K		624.0	
Lowest / Highest Value, K	624.0	624.0	624.0
Permitted Range (0.9T to 1.1T)K	561.6	686.4	

Volumetric flow rate			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m <sup>2</sup> )	
Mean duct velocity	11.9	(m/s)	
Mean duct temperature	351	(°C)	
Ambient pressure	1005	(mbar)	
Vol. Flow rate at stack conditions	8428	(m <sup>3</sup> /hr)	
Vol flow rate corrd.	3658.0	(Nm <sup>3</sup> /hr)	

### 2.3.3 Water vapour measurements

Not applicable.

### 2.3.4 Manual monitoring method - results – calculations

Not applicable.

### 2.3.5 Analysis results

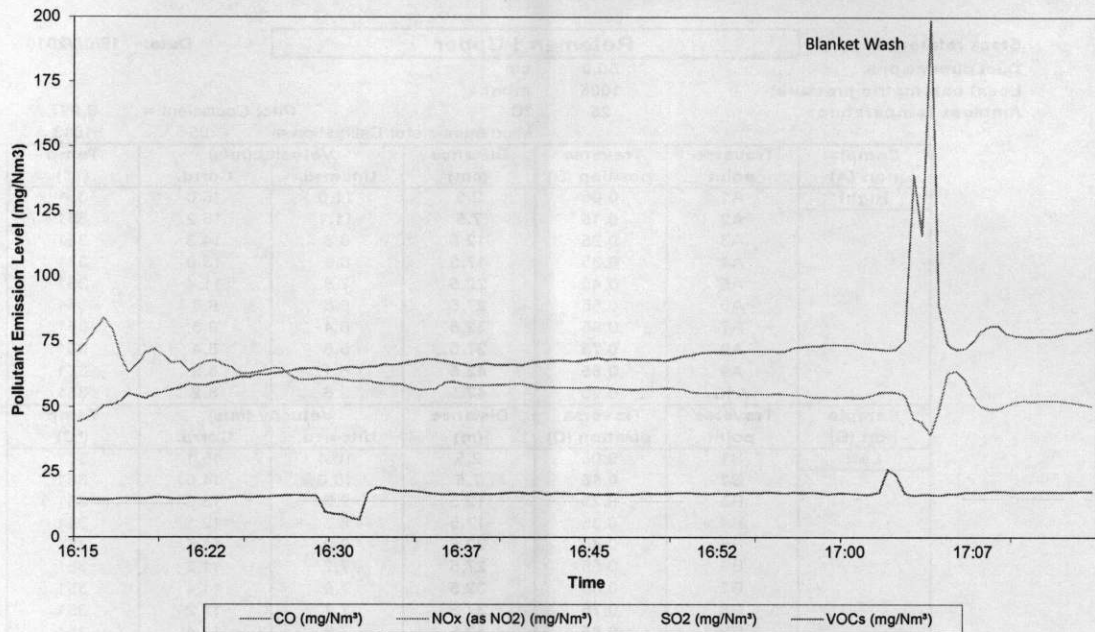
Not applicable.

### 2.3.6 Instrumental gas analyser site calibration measurements

See Section 2.2.6 above.

### 2.3.7 Instrumental gas analyser results

Combustion Gas and VOC Emissions from Rotoman 1 Upper  
Wyndeham Heron, Maldon (18/08/10)



Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers  
Wyndeham Heron, Maldon  
Combustion Gas and VOC Emissions from Rotoman 1 Upper (18/08/10)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO <sub>2</sub> (ppm)	VOCs (ppm)	Results Adjusted for Span and Zero Drift				Conversion from ppm to mg/Nm <sup>3</sup>			
					CO (ppm)	NOx (ppm)	SO <sub>2</sub> (ppm)	VOCs (ppm)	CO (mg/Nm <sup>3</sup> )	NOx (as NO <sub>2</sub> ) (mg/Nm <sup>3</sup> )	SO <sub>2</sub> (mg/Nm <sup>3</sup> )	VOCs (mg/Nm <sup>3</sup> )
Average	54.4	28.5	4.0	10.2	55.7	28.5	4.9	10.2	69.6	58.5	14.0	16.3
Maximum	155.8	40.9	4.3	16.2	159.1	40.9	5.2	16.2	198.9	83.9	14.9	26.1
Minimum	34.6	19.2	3.5	4.1	35.4	19.2	4.4	4.1	44.3	39.4	12.6	6.6

### 2.3.8 Uncertainty calculations

#### UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =  ppm  
Span Gas Certified Value =  ppm +/-2%

Parameter	criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.5440	0.2959
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	1.0880	1.1837
Linearity	0.76% of value	0.4134	0.1709
Setting Gas Divider	0.25% of value	0.1360	0.0185
Interference	2.9% of value	1.5776	2.4888
Span Gas	1% of span gas	0.7970	0.6352

Sum U <sup>2</sup>	5.04
Total U	2.25 ppm
95% confidence	4.49 ppm
or	6.61 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.2850	0.0812
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.5415	0.2932
Linearity	0.49% of value	0.1397	0.0195
Setting Gas Divider	0.25% of value	0.0713	0.0051
Interference	1.2% of value	0.3420	0.1170
Span Gas	1% of span gas	0.6000	0.3600

Sum U <sup>2</sup>	0.97
Total U	0.98 ppm
95% confidence	1.97 ppm
or	4.04 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0400	0.0016
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0760	0.0058
Linearity	1.53% of value	0.0612	0.0037
Setting Gas Divider	0.25% of value	0.0100	0.0001
Interference	1.2% of value	0.0480	0.0023
Span Gas	1% of span gas	1.5290	2.3378

Sum U <sup>2</sup>	2.44
Total U	1.56 ppm
95% confidence	3.12 ppm
or	8.92 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF VOC BY SIGNAL3

Reading =  ppm as C<sub>3</sub>H<sub>8</sub>  
Span Gas =  ppm +/-2%

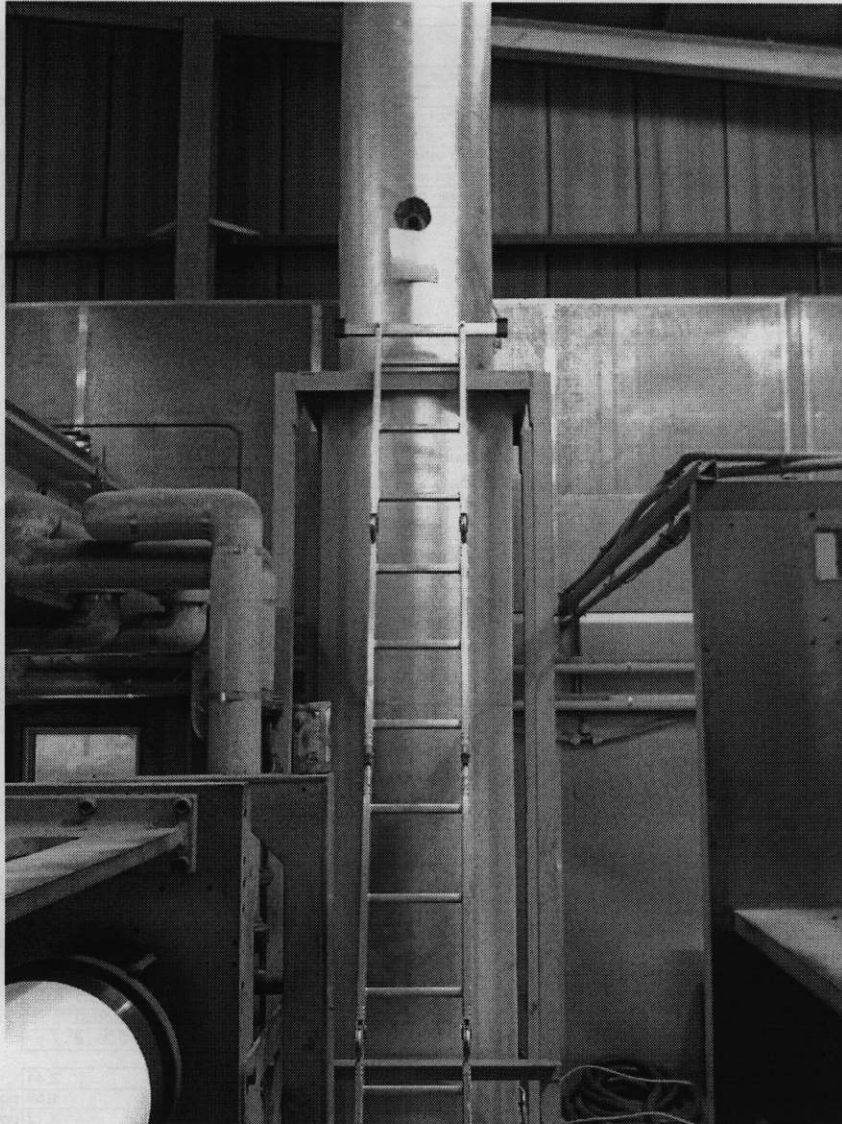
Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.1020	0.0104
Zero Drift/ Detection threshold	0.2ppm	0.2000	0.0400
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.0612	0.0037
Setting Gas Divider	0.25% of value	0.0255	0.0007
Temperature Drift	1% of value	0.1020	0.0104
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.082
Total U	0.286 ppm
95% confidence	0.571 ppm as C <sub>3</sub> H <sub>8</sub>

or  mg/Nm<sup>3</sup> as carbon

## 2.4 Appendix 4: Rotoman 2 Lower Results and Discussions

### 2.4.1 Photograph of the sampling location and positions



### 2.4.2 Flow criteria measurements

#### DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 2 Lower** Date: 17/08/2010  
 Duct dimensions: 50.0 cm  
 Local barometric pressure: 1008 mbar  
 Ambient Temperature: 25 °C Pitot Coefficient = 0.997  
 Micromanometer Calibration (K; mbar) = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	3.4	4.9	350
	A2	0.15	7.5	3.3	4.8	350
	A3	0.25	12.5	3.6	5.2	350
	A4	0.35	17.5	3.1	4.5	350
	A5	0.45	22.5	3.2	4.6	350
	A6	0.55	27.5	3.4	4.9	350
	A7	0.65	32.5	3.1	4.5	350
	A8	0.75	37.5	3.2	4.6	350
	A9	0.85	42.5	2.6	3.8	350
	A10	0.95	47.5	1.8	2.6	350

Velocity readings (m/s)			
Duct Mean m/s	4.5		
Highest(a)	5.2	Lowest (b)	2.6

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

Volumetric flow rate			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m <sup>2</sup> )	
Mean duct velocity	4.5	(m/s)	
Mean duct temperature	350	(°C)	
Ambient pressure	1008	(mbar)	
Vol. Flow rate at stack conditions	3152	(m <sup>3</sup> /hr)	
Vol flow rate corrd.	1374.4	(Nm <sup>3</sup> /hr)	

### 2.4.3 Water vapour measurements

Not applicable.

### 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

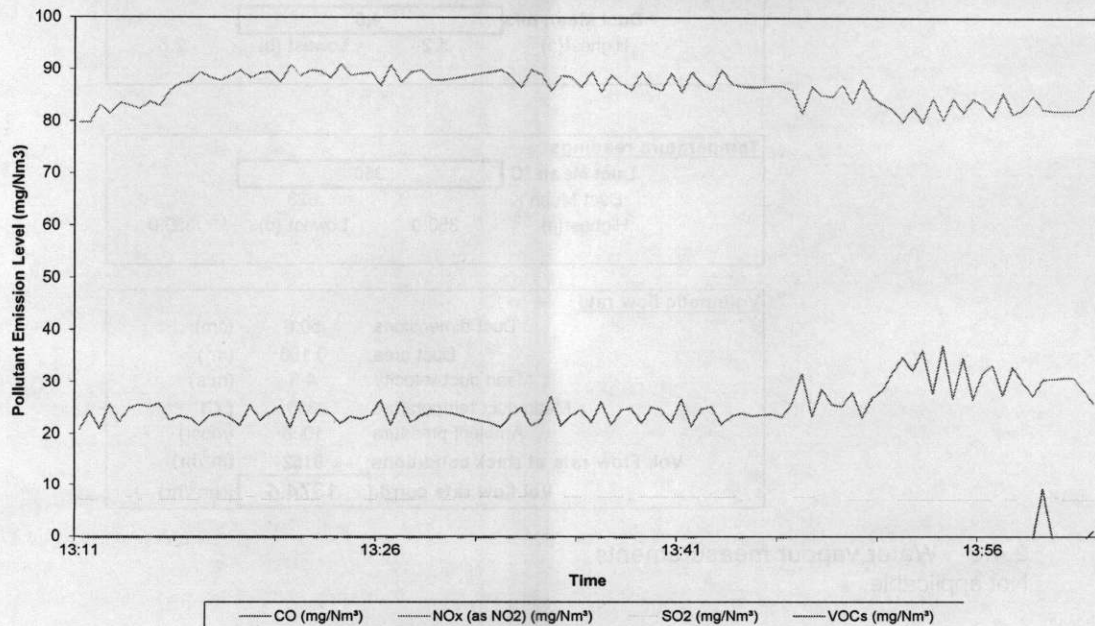
#### Combustion Gas and VOC Emissions from Rotoman 2 (17/08/10)

Data entered by: MR  
Horiba Analyser: Hor 2  
Signal Analyser: Sig 1

Type of Gas	CO		NO		SO2		VOCs	
<b>Certified Calibration Values</b>	80.0	ppm +/-2%	96.0	ppm +/-2%	200.3	ppm +/-2%	7.97	ppm +/-2%
<b>Period</b>								
Span PreCal direct to analyser	79.8	ppm	96.0	ppm	200.2	ppm	0.1	ppm
Zero PreCal through sample line	-0.4	ppm	0.1	ppm	1.3	ppm	7.9	ppm
Span PreCal through sample line	79.2	ppm	94.5	ppm	195.1	ppm	8.0	ppm
Zero PostCal through sample line	0.7	ppm	0.3	ppm	0.2	ppm	-0.4	ppm
Span PostCal through sample line	79.5	ppm	94.5	ppm	185.2	ppm	7.4	ppm
Span Drift	-0.4	%	0.0	%	4.9	%		
Zero Drift	-1.4	%	-0.2	%	0.5	%		
Is data valid without adjustment	YES		YES		NO			
Does data require adjustment	NO		NO		YES			
Is data invalid	NO		NO		NO			

### 2.4.7 Instrumental gas analyser results

#### Combustion Gas and VOC Emissions from Rotoman 2 Lower Wyndeham Heron, Maldon (17/08/10)



#### Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers Wyndeham Heron, Maldon Combustion Gas and VOC Emissions from Rotoman 2 Lower (17/08/10)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO2 (ppm)	VOCs (ppm)	Results Adjusted for Span and Zero Drift				Conversion from ppm to mg/Nm³			
					CO (ppm)	NOx (ppm)	SO2 (ppm)	VOCs (ppm)	CO (mg/Nm³)	NOx (as NO <sub>2</sub> ) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
Average	20.4	42.1	1.3	0.0	20.4	42.1	2.6	0.0	25.5	86.3	7.4	0.0
Maximum	29.7	44.4	1.5	5.8	29.7	44.4	2.8	5.8	37.1	91.1	8.0	9.3
Minimum	16.7	38.9	1.1	0.0	16.7	38.9	2.5	0.0	20.9	79.7	7.1	0.0

## 2.4.8 Uncertainty Calculations

### UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 2

Reading =  ppm  
Span Gas Certified Value =  ppm +/-2%

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.2040	0.0416
Zero Drift/Lower limit of detection	0.5 ppm	0.5000	0.2500
Span Drift	2% of value	0.4080	0.1665
Linearity	0.48% of value	0.0979	0.0096
Setting Gas Divider	0.25% of value	0.0510	0.0026
Interference	2.9% of value	0.5916	0.3500
Span Gas	1% of span gas	0.8000	0.6400

Sum U <sup>2</sup>	1.46
Total U	1.21 ppm
95% confidence	2.42 ppm
or	3.02 mg/Nm <sup>3</sup>

### UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 2

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.4210	0.1772
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.7999	0.6398
Linearity	1.14% of value	0.4799	0.2303
Setting Gas Divider	0.25% of value	0.1053	0.0111
Interference	1.2% of value	0.5052	0.2552
Span Gas	1% of span gas	0.9600	0.9216

Sum U <sup>2</sup>	2.33
Total U	1.52 ppm
95% confidence	3.05 ppm
or	6.26 mg/Nm <sup>3</sup>

### UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 2

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0260	0.0007
Zero Drift/Lower limit of detection	0.1ppm	0.1000	0.0100
Span Drift	1.9% of value	0.0494	0.0024
Linearity	1.82% of value	0.0473	0.0022
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	2.0030	4.0120

Sum U <sup>2</sup>	4.03
Total U	2.01 ppm
95% confidence	4.01 ppm
or	11.46 mg/Nm <sup>3</sup>

### UNCERTAINTY OF VOC BY SIGNAL 1

Reading =  ppm as C<sub>3</sub>H<sub>8</sub>  
Span Gas =  ppm +/-2%

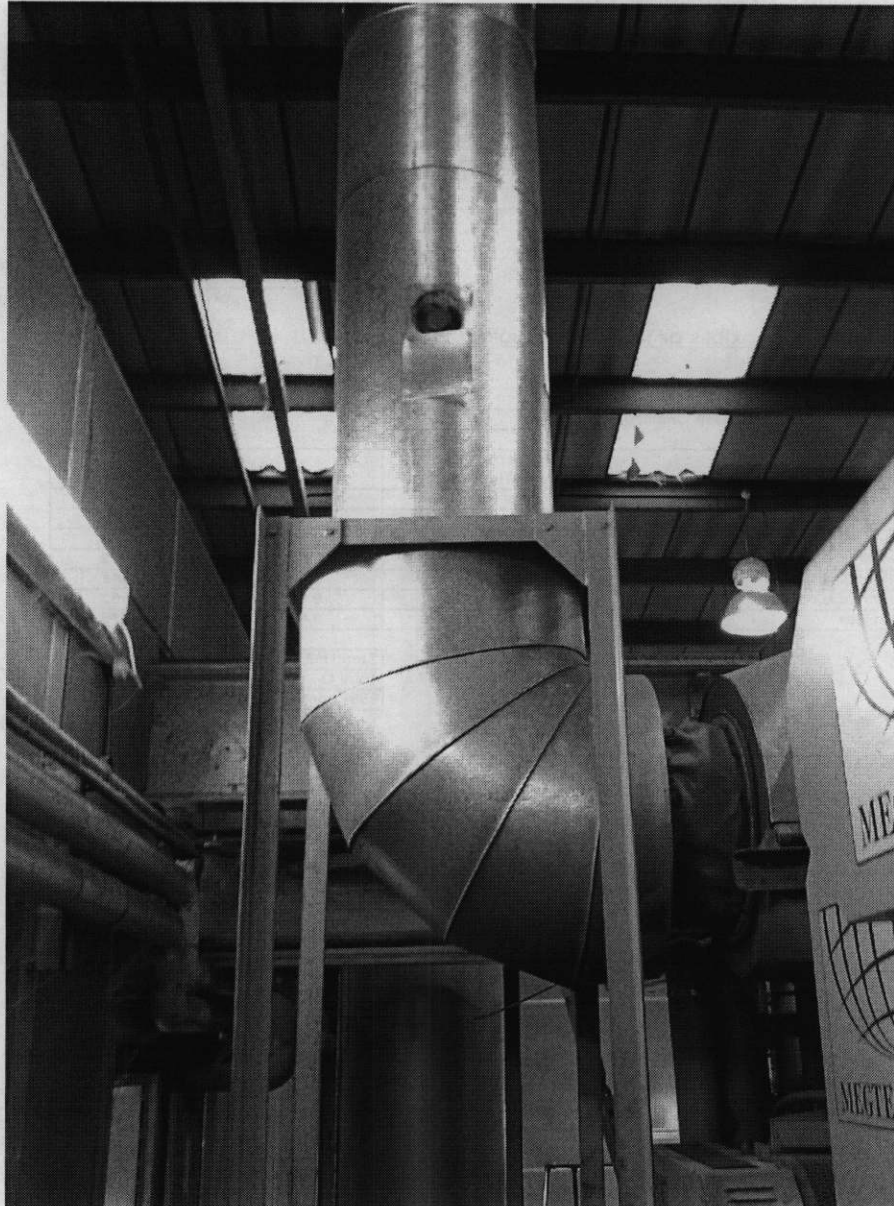
Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0000	0.0000
Zero Drift/ Detection threshold	0.4ppm	0.4000	0.1600
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.0000	0.0000
Setting Gas Divider	0.25% of value	0.0000	0.0000
Temperature Drift	1% of value	0.0000	0.0000
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.18
Total U	0.42 ppm
95% confidence	0.84 ppm as C <sub>3</sub> H <sub>8</sub>

or  mg/Nm<sup>3</sup> as carbon

## 2.5 Appendix 5: Rotoman 2 Upper Results and Discussions

### 2.5.1 Photograph of the sampling location and positions



## 2.5.2 Flow criteria measurements

### DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 2 Upper** Date: 17/08/2010  
 Duct dimensions: 50.0 cm  
 Local barometric pressure: 1008 mbar  
 Ambient Temperature: 25 °C Pitot Coefficient = 0.997  
 Micromanometer Calibration (K; mbar) = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	6.6	9.6	352
	A2	0.15	7.5	5.4	7.9	352
	A3	0.25	12.5	5.2	7.6	352
	A4	0.35	17.5	5.0	7.3	352
	A5	0.45	22.5	5.2	7.6	352
	A6	0.55	27.5	4.5	6.5	352
	A7	0.65	32.5	5.0	7.3	352
	A8	0.75	37.5	6.2	9.0	352
	A9	0.85	42.5	5.8	8.4	352
	A10	0.95	47.5	5.7	8.3	352

Velocity readings (m/s)			
Duct Mean m/s	7.9		
Highest(a)	9.6	Lowest (b)	6.5

Temperature readings			
Duct Mean °C	352		
Duct Mean K	625		
Highest(a)	352.0	Lowest (b)	352.0

Volumetric flow rate			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m <sup>2</sup> )	
Mean duct velocity	7.9	(m/s)	
Mean duct temperature	352	(°C)	
Ambient pressure	1008	(mbar)	
Vol. Flow rate at stack conditions	5615	(m <sup>3</sup> /hr)	
Vol flow rate corrd.	2440.4	(Nm <sup>3</sup> /hr)	

### 2.5.3 Water vapour measurements

Not applicable.

### 2.5.4 Manual monitoring method - results – calculations

Not applicable.

### 2.5.5 Analysis results

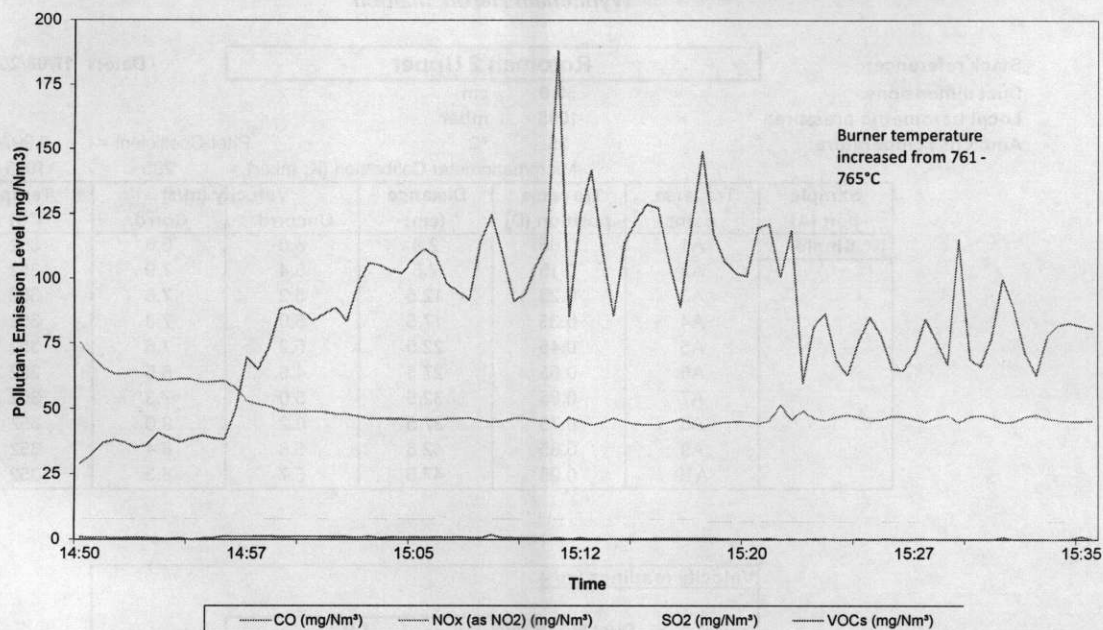
Not applicable.

### 2.5.6 Instrumental gas analyser site calibration measurements

See Section 2.4.6 above.

## 2.5.7 Instrumental gas analyser results

### Combustion Gas and VOC Emissions from Rotoman 2 Upper Wyndeham Heron, Maldon (17/08/10)



#### Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers Wyndeham Heron, Maldon

#### Combustion Gas and VOC Emissions from Rotoman 2 Upper (17/08/10)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO <sub>2</sub> (ppm)	VOCs (ppm)	Results Adjusted for Span and Zero Drift				Conversion from ppm to mg/Nm <sup>3</sup>			
					CO (ppm)	NOx (ppm)	SO <sub>2</sub> (ppm)	VOCs (ppm)	CO (mg/Nm <sup>3</sup> )	NOx (as NO <sub>2</sub> ) (mg/Nm <sup>3</sup> )	SO <sub>2</sub> (mg/Nm <sup>3</sup> )	VOCs (mg/Nm <sup>3</sup> )
Average	68.9	23.9	1.3	0.3	68.9	23.9	2.6	0.3	86.1	49.1	7.4	0.5
Maximum	150.6	36.7	1.5	1.1	150.6	36.7	2.8	1.1	188.2	75.3	8.1	1.8
Minimum	23.3	20.9	1.0	0.0	23.3	20.9	2.3	0.0	29.1	43.0	6.5	0.0

### 2.5.8 Uncertainty calculations

#### UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 2

Reading =  ppm  
Span Gas Certified Value =  ppm +/-2%

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.6890	0.4747
Zero Drift/Lower limit of detection	0.5 ppm	0.5000	0.2500
Span Drift	2% of value	1.3780	1.8989
Linearity	0.48% of value	0.3307	0.1094
Setting Gas Divider	0.25% of value	0.1723	0.0297
Interference	2.9% of value	1.9981	3.9924
Span Gas	1% of span gas	0.8000	0.6400

Sum U <sup>2</sup>	7.40
Total U	2.72 ppm
95% confidence	5.44 ppm
or	<b>6.80 mg/Nm<sup>3</sup></b>

#### UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 2

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.2390	0.0571
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.4541	0.2062
Linearity	1.14% of value	0.2725	0.0742
Setting Gas Divider	0.25% of value	0.0598	0.0036
Interference	1.2% of value	0.2868	0.0823
Span Gas	1% of span gas	0.9600	0.9216

Sum U <sup>2</sup>	1.43
Total U	1.20 ppm
95% confidence	2.40 ppm
or	<b>4.92 mg/Nm<sup>3</sup></b>

#### UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 2

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0260	0.0007
Zero Drift/Lower limit of detection	0.1ppm	0.1000	0.0100
Span Drift	1.9% of value	0.0494	0.0024
Linearity	1.82% of value	0.0473	0.0022
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	2.0030	4.0120

Sum U <sup>2</sup>	4.03
Total U	2.01 ppm
95% confidence	4.01 ppm
or	<b>11.46 mg/Nm<sup>3</sup></b>

#### UNCERTAINTY OF VOC BY SIGNAL 1

Reading =  ppm as C<sub>3</sub>H<sub>8</sub>  
Span Gas =  ppm +/-2%

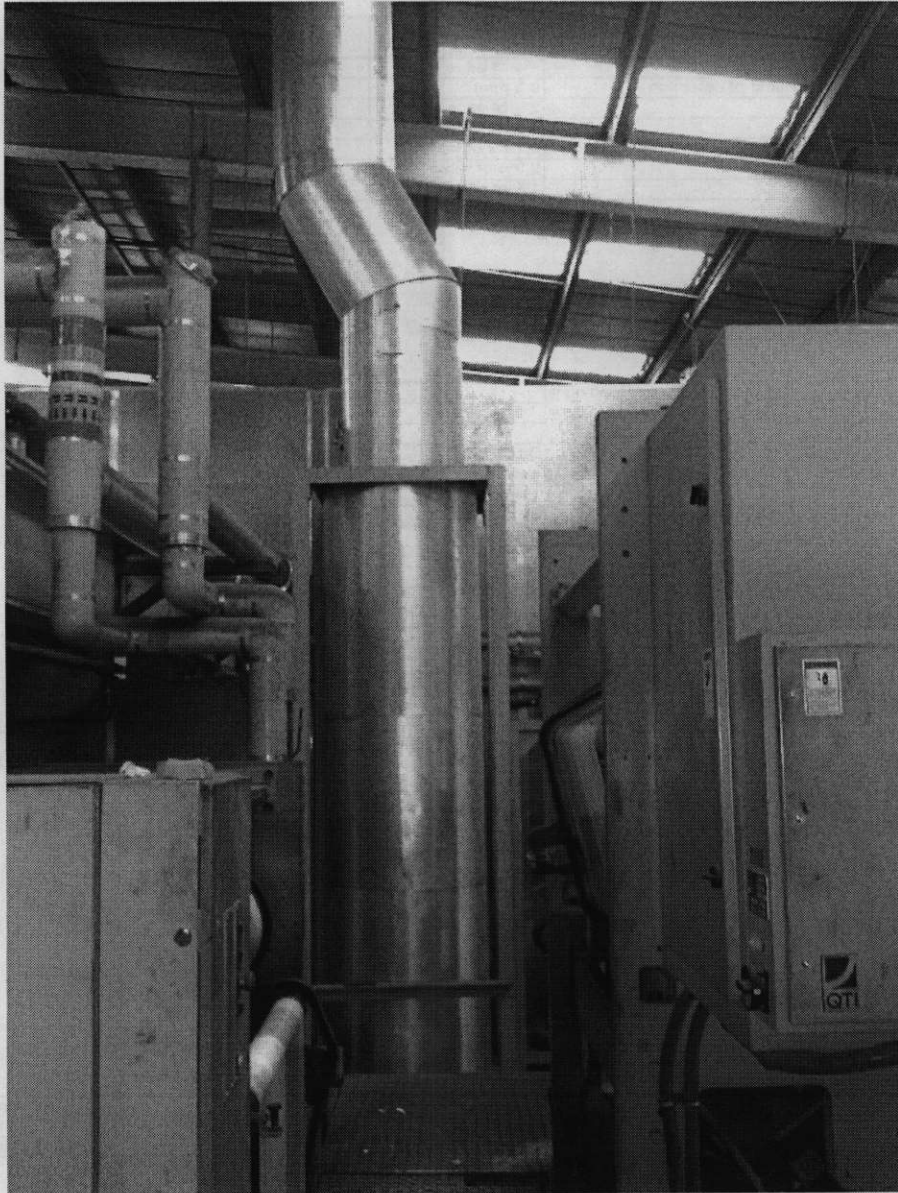
Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0030	0.0000
Zero Drift/ Detection threshold	0.4ppm	0.4000	0.1600
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.0018	0.0000
Setting Gas Divider	0.25% of value	0.0008	0.0000
Temperature Drift	1% of value	0.0030	0.0000
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.18
Total U	0.42 ppm
95% confidence	0.84 ppm as C <sub>3</sub> H <sub>8</sub>

or  mg/Nm<sup>3</sup> as carbon

## 2.6 Appendix 6: Rotoman 3 Lower Results and Discussions

### 2.6.1 Photograph of the sampling location and positions



## 2.6.2 Flow criteria measurements

### DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 3 Lower** Date: 16/08/2010  
 Duct dimensions: 50.0 cm  
 Local barometric pressure: 1014 mbar  
 Ambient Temperature: 25 °C Pitot Coefficient = 0.997  
 Micromanometer Calibration (K; mbar) = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	5.6	8.2	359
	A2	0.15	7.5	6.2	9.0	359
	A3	0.25	12.5	6.4	9.3	359
	A4	0.35	17.5	6.3	9.2	359
	A5	0.45	22.5	5.0	7.3	359
	A6	0.55	27.5	5.3	7.7	359
	A7	0.65	32.5	5.8	8.5	359
	A8	0.75	37.5	5.4	7.9	359
	A9	0.85	42.5	5.3	7.7	359
	A10	0.95	47.5	5.1	7.4	359

Velocity readings (m/s)			
Duct Mean m/s	8.2		
Highest(a)	9.3	Lowest (b)	7.3

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

Volumetric flow rate			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m <sup>2</sup> )	
Mean duct velocity	8.2	(m/s)	
Mean duct temperature	359	(°C)	
Ambient pressure	1014	(mbar)	
Vol. Flow rate at stack conditions	5815	(m <sup>3</sup> /hr)	
Vol flow rate corrd.	2514.3	(Nm <sup>3</sup> /hr)	

2.6.3 Water vapour measurements  
Not applicable.

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**

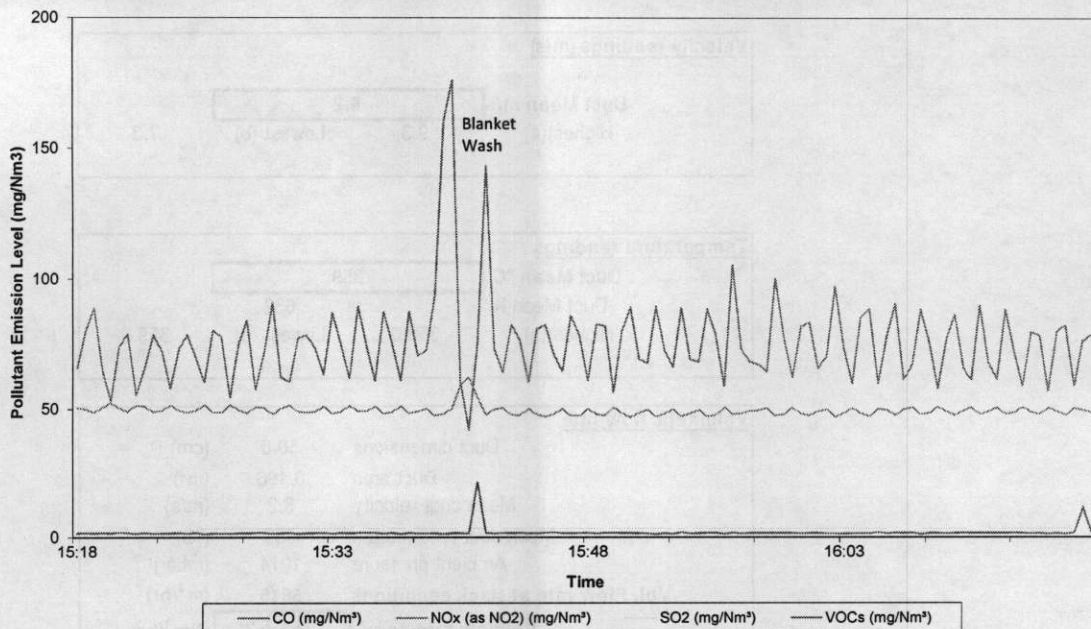
**Combustion Gas and VOC Emissions from Rotoman 3 (16/08/10)**

Data entered by: MR  
Horiba Analyser: Hor 2  
Signal Analyser: Sig 1

Type of Gas	CO		NO		SO2		VOCs	
<b>Certified Calibration Values</b>	80.0	ppm +/-2%	96.0	ppm +/-2%	200.3	ppm +/-2%	7.97	ppm +/-2%
<b>Period</b>								
Span PreCal direct to analyser	80.0	ppm	96.2	ppm	200.4	ppm	8.1	ppm
Zero PreCal through sample line	0.0	ppm	0.1	ppm	0.3	ppm	0.0	ppm
Span PreCal through sample line	78.5	ppm	95.4	ppm	192.3	ppm	7.7	ppm
Zero PostCal through sample line	0.4	ppm	0.5	ppm	0.1	ppm	0.3	ppm
Span PostCal through sample line	78.0	ppm	96.1	ppm	192.7	ppm	8.2	ppm
Span Drift	0.6	%	-0.7	%	-0.2	%		
Zero Drift	-0.5	%	-0.4	%	0.1	%		
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

**Combustion Gas and VOC Emissions from Rotoman 3 Lower Drier  
Wyndeham Heron, Maldon (16/08/10)**



**Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers**

Wyndeham Heron, Maldon

**Combustion Gas and VOC Emissions from Rotoman 3 Lower Drier (16/08/10)**

	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 NO₂) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
<b>Average</b>	60.7	24.2	1.2	1.2	75.9	49.6	3.6	1.9
<b>Maximum</b>	141.1	30.4	1.4	13.6	176.3	62.4	4.1	21.9
<b>Minimum</b>	33.7	22.9	1.1	0.7	42.1	47.0	3.0	1.1

### 2.6.8 Uncertainty calculations

#### UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 2

Reading = 60.7 ppm  
Span Gas Certified Value = 80.0 ppm +/-2%

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.6070	0.3684
Zero Drift/Lower limit of detection	0.5 ppm	0.5000	0.2500
Span Drift	2% of value	1.2140	1.4738
Linearity	0.48% of value	0.2914	0.0849
Setting Gas Divider	0.25% of value	0.1518	0.0230
Interference	2.9% of value	1.7603	3.0987
Span Gas	1% of span gas	0.8000	0.6400

Sum U <sup>2</sup>	5.94
Total U	2.44 ppm
95% confidence	4.87 ppm
or	6.09 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 2

Reading = 24.2 ppm  
Span Gas Certified Value = 96.0 ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.2420	0.0586
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.4598	0.2114
Linearity	1.14% of value	0.2759	0.0761
Setting Gas Divider	0.25% of value	0.0605	0.0037
Interference	1.2% of value	0.2904	0.0843
Span Gas	1% of span gas	0.9600	0.9216

Sum U <sup>2</sup>	1.45
Total U	1.20 ppm
95% confidence	2.40 ppm
or	4.94 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 2

Reading = 1.2 ppm  
Span Gas Certified Value = 200.3 ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0120	0.0001
Zero Drift/Lower limit of detection	0.1ppm	0.1000	0.0100
Span Drift	1.9% of value	0.0228	0.0005
Linearity	1.82% of value	0.0218	0.0005
Setting Gas Divider	0.25% of value	0.0030	0.0000
Interference	1.2% of value	0.0144	0.0002
Span Gas	1% of span gas	2.0030	4.0120

Sum U <sup>2</sup>	4.02
Total U	2.01 ppm
95% confidence	4.01 ppm
or	11.45 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF VOC BY SIGNAL 1

Reading = 1.2 ppm as C3H8  
Span Gas = 7.97 ppm +/-2%

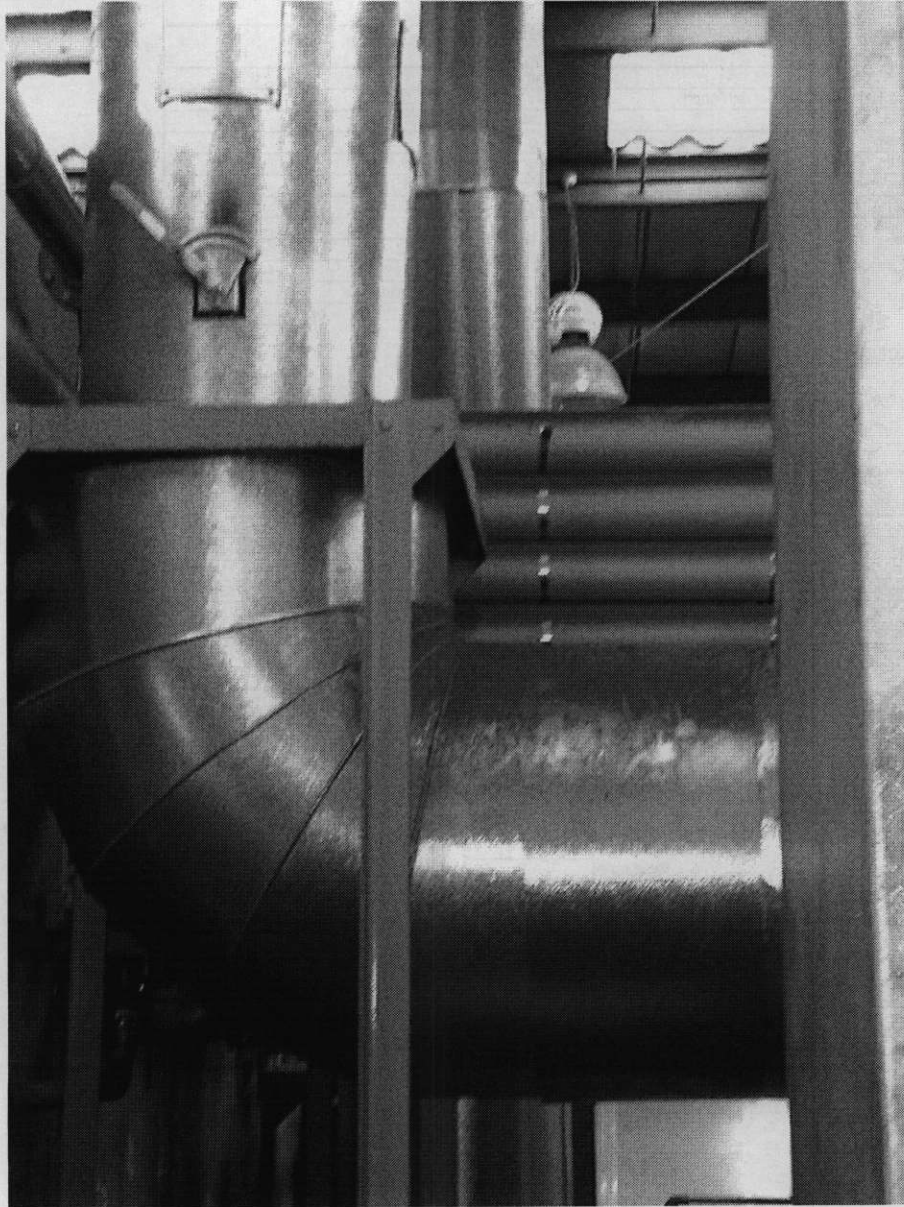
Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0120	0.0001
Zero Drift/ Detection threshold	0.4ppm	0.4000	0.1600
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.0072	0.0001
Setting Gas Divider	0.25% of value	0.0030	0.0000
Temperature Drift	1% of value	0.0120	0.0001
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.18
Total U	0.42 ppm
95% confidence	0.84 ppm as C3H8

or 1.35 mg/Nm<sup>3</sup> as carbon

## 2.7 Appendix 7: Rotoman 3 Upper Results and Discussions

### 2.7.1 Photograph of the sampling location and positions



## 2.7.2 Flow criteria measurements

### DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 3 Upper** Date: 16/08/2010  
 Duct dimensions: 50.0 cm  
 Local barometric pressure: 1014 mbar  
 Ambient Temperature: 25 °C Pitot Coefficient = 0.997  
 Micromanometer Calibration (K; mbar) = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	3.8	5.6	364
	A2	0.15	7.5	3.9	5.7	364
	A3	0.25	12.5	5.5	8.1	364
	A4	0.35	17.5	5.5	8.1	364
	A5	0.45	22.5	5.1	7.5	364
	A6	0.55	27.5	4.5	6.6	364
	A7	0.65	32.5	4.9	7.2	364
	A8	0.75	37.5	5.0	7.3	364
	A9	0.85	42.5	6.5	9.5	364
	A10	0.95	47.5	6.3	9.2	364

#### Velocity readings (m/s)

Duct Mean m/s **7.5**  
 Highest(a) 9.5 Lowest (b) 5.6

#### Temperature readings

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

#### Volumetric flow rate

Duct dimensions 50.0 (cm)  
 Duct area 0.196 (m<sup>2</sup>)  
 Mean duct velocity 7.5 (m/s)  
 Mean duct temperature 364 (°C)  
 Ambient pressure 1014 (mbar)  
**Vol. Flow rate at stack conditions 5279 (m<sup>3</sup>/hr)**  
**Vol flow rate corrd. 2264.6 (Nm<sup>3</sup>/hr)**

## 2.7.3 Water vapour measurements

Not applicable.

## 2.7.4 Manual monitoring method - results – calculations

Not applicable.

## 2.7.5 Analysis results

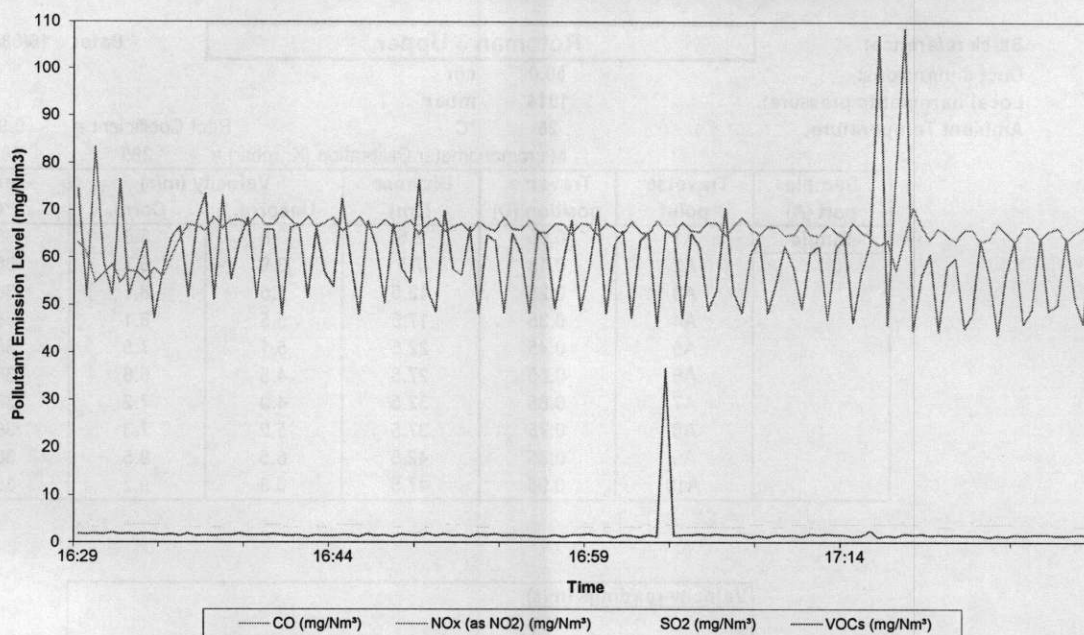
Not applicable.

## 2.7.6 Instrumental gas analyser site calibration measurements

See Section 2.6.6 above

## 2.7.7 Instrumental gas analyser results

### Combustion Gas and VOC Emissions from Rotoman 3 Upper Drier Wyndeham Heron, Maldon (16/08/10)



### Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers

Wyndeham Heron, Maldon

### Combustion Gas and VOC Emissions from Rotoman 3 Upper Drier (16/08/10)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	Sulphur Dioxide SO <sub>2</sub> (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm <sup>3</sup>			
					CO (mg/Nm <sup>3</sup> )	NOx (as NO <sub>2</sub> ) (mg/Nm <sup>3</sup> )	SO <sub>2</sub> (mg/Nm <sup>3</sup> )	VOCs (mg/Nm <sup>3</sup> )
<b>Average</b>	47.5	31.8	1.2	1.2	59.4	65.3	3.6	1.9
<b>Maximum</b>	86.9	34.4	1.4	22.8	108.6	70.6	4.0	36.7
<b>Minimum</b>	35.0	26.6	1.1	0.7	43.8	54.7	3.0	1.1

### 2.7.8 Uncertainty calculations

#### UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 2

Reading = 47.5 ppm  
Span Gas Certified Value = 80.0 ppm +/-2%

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.4750	0.2256
Zero Drift/Lower limit of detection	0.5 ppm	0.5000	0.2500
Span Drift	2% of value	0.9500	0.9025
Linearity	0.48% of value	0.2280	0.0520
Setting Gas Divider	0.25% of value	0.1188	0.0141
Interference	2.9% of value	1.3775	1.8975
Span Gas	1% of span gas	0.8000	0.6400

Sum U <sup>2</sup>	3.98
Total U	2.00 ppm
95% confidence	3.99 ppm
or	4.99 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 2

Reading = 31.8 ppm  
Span Gas Certified Value = 96.0 ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
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	0.3651
Linearity	1.14% of value	0.3625	0.1314
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	0.9600	0.9216

Sum U <sup>2</sup>	1.76
Total U	1.33 ppm
95% confidence	2.65 ppm
or	5.45 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 2

Reading = 1.2 ppm  
Span Gas Certified Value = 200.3 ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0120	0.0001
Zero Drift/Lower limit of detection	0.1ppm	0.1000	0.0100
Span Drift	1.9% of value	0.0228	0.0005
Linearity	1.82% of value	0.0218	0.0005
Setting Gas Divider	0.25% of value	0.0030	0.0000
Interference	1.2% of value	0.0144	0.0002
Span Gas	1% of span gas	2.0030	4.0120

Sum U <sup>2</sup>	4.02
Total U	2.01 ppm
95% confidence	4.01 ppm
or	11.45 mg/Nm <sup>3</sup>

#### UNCERTAINTY OF VOC BY SIGNAL 1

Reading = 1.2 ppm as C3H8  
Span Gas = 7.97 ppm +/-2%

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0120	0.0001
Zero Drift/ Detection threshold	0.4ppm	0.4000	0.1600
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.0072	0.0001
Setting Gas Divider	0.25% of value	0.0030	0.0000
Temperature Drift	1% of value	0.0120	0.0001
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.18
Total U	0.42 ppm
95% confidence	0.84 ppm as C3H8

or 1.35 mg/Nm<sup>3</sup> as carbon

## 2.8 Appendix 8: Lithoman 1 Results and Discussions

### 2.8.1 Photograph of the sampling location and positions



## 2.8.2 Flow criteria measurements

### DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Lithoman 1** Date: 17/08/2010  
 Duct dimensions: 55.0 cm  
 Local barometric pressure: 1008 mbar  
 Ambient Temperature: 25 °C Pitot Coefficient = 0.997  
 Micromanometer Calibration (K; mbar) = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.8	5.8	8.1	309
	A2	0.15	8.3	3.0	4.2	309
	A3	0.25	13.8	11.5	16.1	309
	A4	0.35	19.3	10.5	14.7	309
	A5	0.45	24.8	7.1	10.0	309
	A6	0.55	30.3	0.0	0.0	309
	A7	0.65	35.8	0.0	0.0	309
	A8	0.75	41.3	0.0	0.0	309
	A9	0.85	46.8	0.0	0.0	309
	A10	0.95	52.3	0.0	0.0	309

#### Velocity readings (m/s)

Duct Mean m/s **5.3**  
 Highest(a) 16.1 Lowest (b) 0.0

#### Temperature readings

Duct Mean °C **309**  
 Duct Mean K 582  
 Highest(a) 309.0 Lowest (b) 309.0

#### Volumetric flow rate

Duct dimensions 55.0 (cm)  
 Duct area 0.238 (m<sup>2</sup>)  
 Mean duct velocity 5.3 (m/s)  
 Mean duct temperature 309 (°C)  
 Ambient pressure 1008 (mbar)  
 Vol. Flow rate at stack conditions 4551 (m<sup>3</sup>/hr)  
 Vol flow rate corrd. **2124.1** (Nm<sup>3</sup>/hr)

## 2.8.3 Water vapour measurements

Not applicable.

## 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 Lithoman 1 (17/08/10)

Data entered by: MR

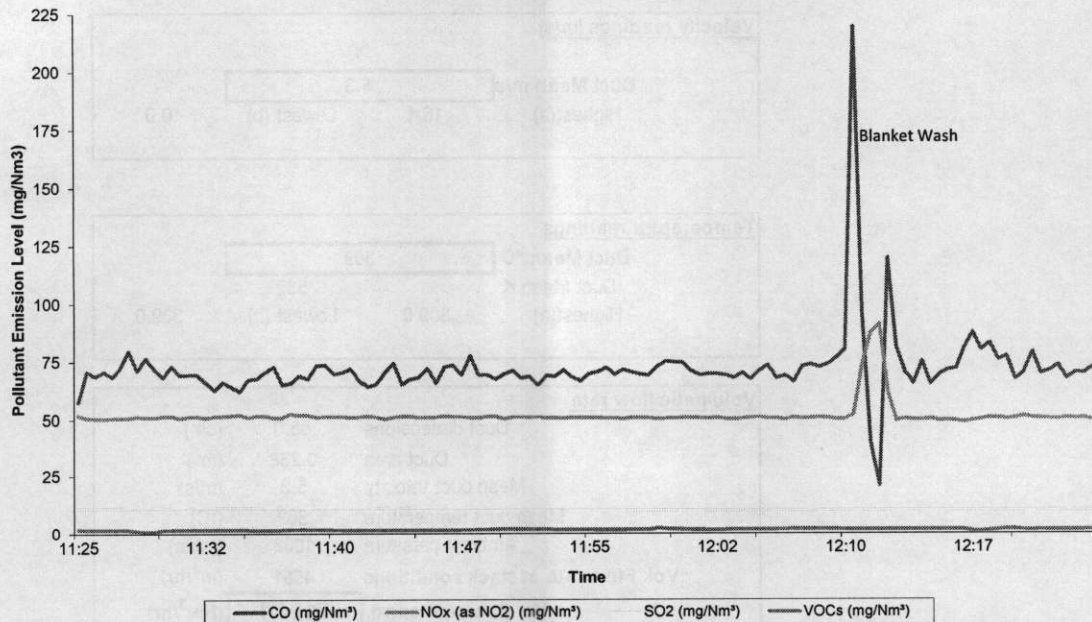
Horiba Analyser: Hor 1

Signal Analyser: Sig 3

Type of Gas	CO		NO		SO2		VOCs	
<b>Certified Calibration Values</b>	79.7	ppm +/-2%	60.0	ppm +/-2%	159.2	ppm +/-2%	7.97	ppm +/-2%
<b>Period</b>								
Span PreCal direct to analyser	80.2	ppm	60.2	ppm	153.1	ppm	8.0	ppm
Zero PreCal through sample line	0.3	ppm	0.1	ppm	0.4	ppm	-0.1	ppm
Span PreCal through sample line	79.8	ppm	60.3	ppm	149.6	ppm	8.6	ppm
Zero PostCal through sample line	0.6	ppm	0.2	ppm	0.1	ppm	0.0	ppm
Span PostCal through sample line	79.1	ppm	60.3	ppm	149.1	ppm	8.6	ppm
Span Drift	0.9	%	0.0	%	0.3	%		
Zero Drift	-0.4	%	-0.2	%	0.2	%		
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

#### Combustion Gas and VOC Emissions from Lithoman 1 Wyndeham Heron, Maldon (17/08/10)



#### Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers

Wyndeham Heron, Maldon

#### Combustion Gas and VOC Emissions from Lithoman 1 (17/08/10)

	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 NO₂) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
<b>Average</b>	56.7	24.8	3.6	1.1	70.9	51.0	10.3	1.7
<b>Maximum</b>	70.6	25.6	3.8	1.5	88.3	52.6	11.0	2.4
<b>Minimum</b>	46.2	24.0	3.3	0.6	57.8	49.3	9.5	1.0

### 2.8.8 Uncertainty calculations

**UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1**

Reading =  ppm  
Span Gas Certified Value =  ppm +/-2%

Parameter	criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.5670	0.3215
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	1.1340	1.2860
Linearity	0.76% of value	0.4309	0.1857
Setting Gas Divider	0.25% of value	0.1418	0.0201
Interference	2.9% of value	1.6443	2.7037
Span Gas	1% of span gas	0.8000	0.6400

Sum U <sup>2</sup>	5.41	
Total U	2.33	ppm
95% confidence	4.65	ppm
or	5.81	mg/Nm <sup>3</sup>

**UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1**

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.2480	0.0615
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.4712	0.2220
Linearity	0.49% of value	0.1215	0.0148
Setting Gas Divider	0.25% of value	0.0620	0.0038
Interference	1.2% of value	0.2976	0.0886
Span Gas	1% of span gas	0.6000	0.3600

Sum U <sup>2</sup>	0.84	
Total U	0.92	ppm
95% confidence	1.83	ppm
or	3.76	mg/Nm <sup>3</sup>

**UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1**

Reading =  ppm  
Span Gas Certified Value =  ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
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	0.0551	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	1.5290	2.3378

Sum U <sup>2</sup>	2.44	
Total U	1.56	ppm
95% confidence	3.12	ppm
or	8.92	mg/Nm <sup>3</sup>

**UNCERTAINTY OF VOC BY SIGNAL3**

Reading =  ppm as C<sub>3</sub>H<sub>8</sub>  
Span Gas =  ppm +/-2%

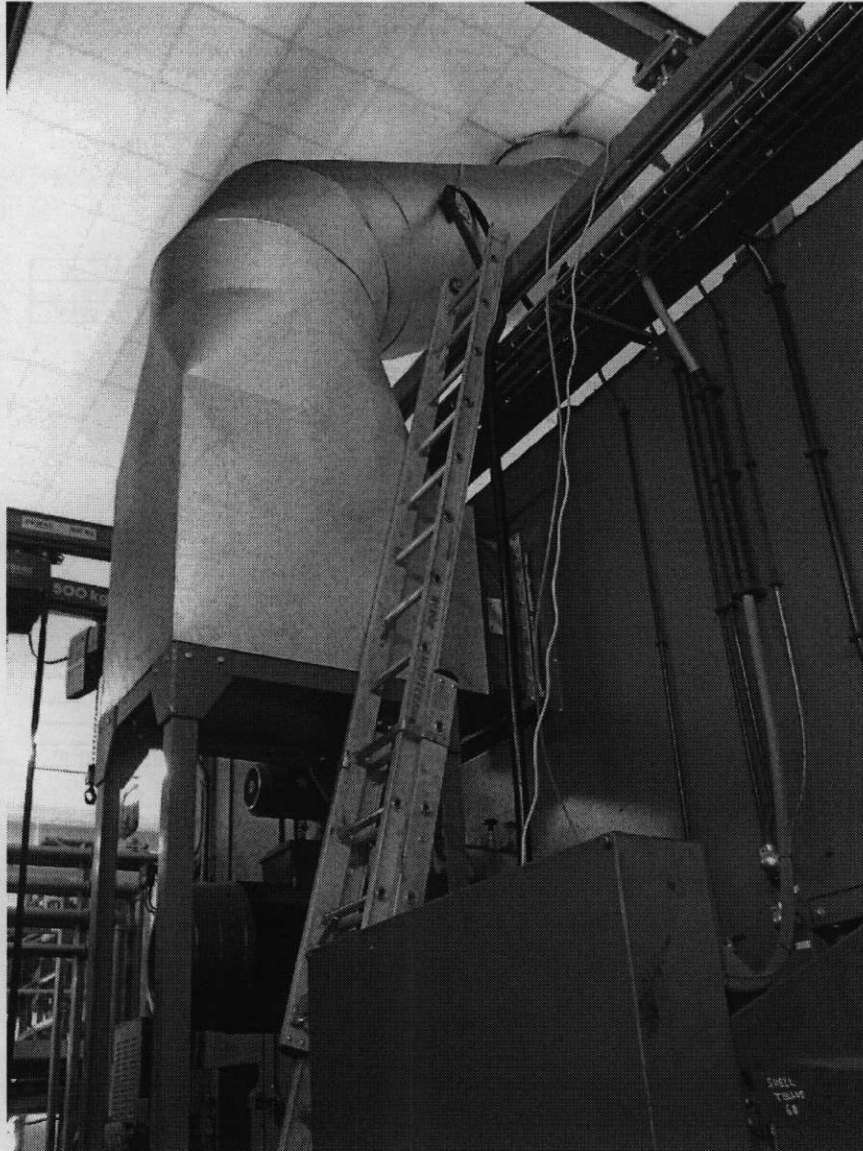
Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0110	0.0001
Zero Drift/ Detection threshold	0.2ppm	0.2000	0.0400
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.0066	0.0000
Setting Gas Divider	0.25% of value	0.0028	0.0000
Temperature Drift	1% of value	0.0110	0.0001
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.057	
Total U	0.238	ppm
95% confidence	0.476	ppm as C <sub>3</sub> H <sub>8</sub>

or  mg/Nm<sup>3</sup> as carbon

**2.9 Appendix 9: Lithoman 2 Results and Discussions**

**2.9.1 Photograph of the sampling location and positions**



**2.9.2 Flow criteria measurements**

**DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA**  
**Wyndeham Heron, Maldon**

Stack reference: **Lithoman 2** Date: 16/08/2010  
 Duct dimensions: 75.0 cm  
 Local barometric pressure: 1014 mbar  
 Ambient Temperature: 25 °C Pitot Coefficient = 0.997  
 Micromanometer Calibration (K; mbar) = 295 1013

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	3.8	5.6	7.9	316
	A2	0.15	11.3	5.5	7.7	316
	A3	0.25	18.8	5.6	7.9	316
	A4	0.35	26.3	5.5	7.7	316
	A5	0.45	33.8	5.3	7.5	316
	A6	0.55	41.3	5.1	7.2	316
	A7	0.65	48.8	4.9	6.9	316
	A8	0.75	56.3	5.6	7.9	316
	A9	0.85	63.8	5.7	8.0	316
	A10	0.95	71.3	5.1	7.2	316

Velocity readings (m/s)			
Duct Mean m/s	7.6		
Highest(a)	8.0	Lowest (b)	6.9

Temperature readings			
Duct Mean °C	316		
Duct Mean K	589		
Highest(a)	316.0	Lowest (b)	316.0

Volumetric flow rate			
Duct dimensions	75.0	(cm)	
Duct area	0.442	(m <sup>2</sup> )	
Mean duct velocity	7.6	(m/s)	
Mean duct temperature	316	(°C)	
Ambient pressure	1014	(mbar)	
Vol. Flow rate at stack conditions	12071	(m <sup>3</sup> /hr)	
Vol flow rate corrd.	5600.2	(Nm <sup>3</sup> /hr)	

**2.9.3 Water vapour measurements**  
Not applicable.

**2.9.4 Manual monitoring method - results – calculations**  
Not applicable.

**2.9.5 Analysis results**  
Not applicable.

**2.9.6 Instrumental gas analyser site calibration measurements**

**ANALYSER CALIBRATIONS**

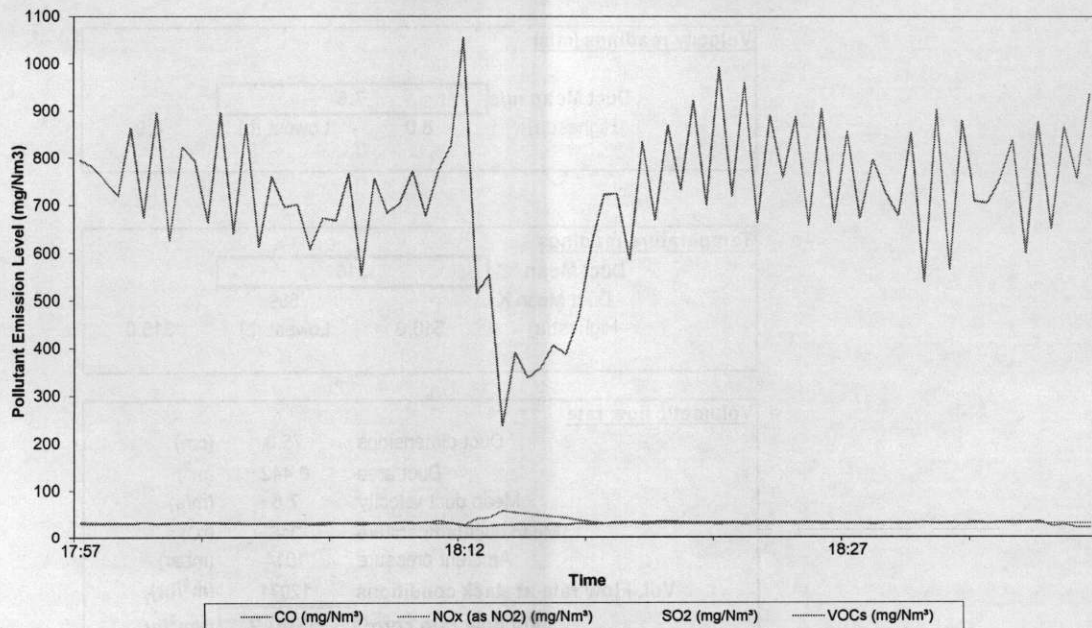
**Combustion Gas and VOC Emissions from Lithoman 2 (16/08/10)**

Data entered by: MR  
Horiba Analyser: Hor 1  
Signal Analyser: Sig 3

Type of Gas	CO		NO		SO2		VOCs	
<b>Certified Calibration Values</b>	79.7	ppm +/-2%	60.0	ppm +/-2%	152.9	ppm +/-2%	7.97	ppm +/-2%
<b>Period</b>								
Span PreCal direct to analyser	78.6	ppm	60.1	ppm	152.7	ppm	8.0	ppm
Zero PreCal through sample line	-0.1	ppm	0.1	ppm	0.8	ppm	0.0	ppm
Span PreCal through sample line	79.2	ppm	60.0	ppm	149.8	ppm	9.0	ppm
Zero PostCal through sample line	1.0	ppm	0.0	ppm	0.9	ppm	-0.1	ppm
Span PostCal through sample line	78.9	ppm	59.7	ppm	151.1	ppm	9.7	ppm
Span Drift	0.4	%	0.5	%	-0.9	%		
Zero Drift	-1.4	%	0.2	%	-0.1	%		
Is data valid without adjustment	YES		YES		YES			
Does data require adjustment	NO		NO		NO			
Is data invalid	NO		NO		NO			

**2.9.7 Instrumental gas analyser results**

**Combustion Gas and VOC Emissions from Lithoman 2  
Wyndeham Heron, Maldon (16/08/2010)**



**Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers**

Wyndeham Heron, Maldon

**Combustion Gas and VOC Emissions from Lithoman 2 (16/08/10)**

	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 NO2) (mg/Nm³)	SO2 (mg/Nm³)	VOCs (mg/Nm³)
<b>Average</b>	574.0	15.9	5.2	19.2	717.5	32.7	14.7	30.9
<b>Maximum</b>	845.0	27.6	5.8	22.5	1056.3	56.7	16.4	36.2
<b>Minimum</b>	189.2	13.3	4.6	13.4	236.5	27.4	13.1	21.5

**2.9.8 Uncertainty calculations**

**UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1**

Reading = 574.0 ppm  
Span Gas Certified Value = 79.7 ppm +/-2%

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	5.7400	32.9476
Zero Drift/Lower limit of detection	0.5ppm	0.5000	0.2500
Span Drift	2% of value	11.4800	131.7904
Linearity	0.76% of value	4.3624	19.0305
Setting Gas Divider	0.25% of value	1.4350	2.0592
Interference	2.9% of value	16.6460	277.0893
Span Gas	1% of span gas	0.7970	0.6352

Sum U <sup>2</sup>	463.80
Total U	21.54 ppm
95% confidence	43.07 ppm
or	53.84 mg/Nm <sup>3</sup>

**UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1**

Reading = 15.9 ppm  
Span Gas Certified Value = 60.0 ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.1590	0.0253
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.3021	0.0913
Linearity	0.49% of value	0.0779	0.0061
Setting Gas Divider	0.25% of value	0.0398	0.0016
Interference	1.2% of value	0.1908	0.0364
Span Gas	1% of span gas	0.6000	0.3600

Sum U <sup>2</sup>	0.61
Total U	0.78 ppm
95% confidence	1.56 ppm
or	3.21 mg/Nm <sup>3</sup>

**UNCERTAINTY OF SULPHUR DIOXIDE BY HORIBA 1**

Reading = 5.2 ppm  
Span Gas Certified Value = 152.9 ppm

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.0520	0.0027
Zero Drift/Lower limit of detection	0.3ppm	0.3000	0.0900
Span Drift	1.9% of value	0.0988	0.0098
Linearity	1.53% of value	0.0796	0.0063
Setting Gas Divider	0.25% of value	0.0130	0.0002
Interference	1.2% of value	0.0624	0.0039
Span Gas	1% of span gas	1.5290	2.3378

Sum U <sup>2</sup>	2.45
Total U	1.57 ppm
95% confidence	3.13 ppm
or	8.94 mg/Nm <sup>3</sup>

**UNCERTAINTY OF VOC BY SIGNAL3**

Reading = 19.2 ppm as C<sub>3</sub>H<sub>8</sub>  
Span Gas = 7.97 ppm +/-2%

Parameter	Uncertainty criteria	U	U <sup>2</sup>
Repeatability	1% of value	0.1920	0.0369
Zero Drift/ Detection threshold	0.2ppm	0.2000	0.0400
Noise	0.1 ppm	0.1000	0.0100
Linearity	0.6% of value	0.1152	0.0133
Setting Gas Divider	0.25% of value	0.0480	0.0023
Temperature Drift	1% of value	0.1920	0.0369
Span Gas	1% of Value	0.0797	0.0064

Sum U <sup>2</sup>	0.146
Total U	0.382 ppm
95% confidence	0.763 ppm as C <sub>3</sub> H <sub>8</sub>

or 1.23 mg/Nm<sup>3</sup> as carbon

**2.10 Appendix 10: Compactor Results and Discussions**

### 2.10.1 Photograph of the sampling location and positions



### 2.10.2 Flow criteria measurements

AIR FLOW DATA				Corrected Volume Flow (Nm <sup>3</sup> /hr)
Duct Diameter (cm)	Air Temp. (°C)	Mean Slot Velocity (m/s) <sup>(1)</sup>	Volume Flow (m <sup>3</sup> /hr)	
60.00	24	23.00	8428.01	7708.7
60.00	24	16.00	5862.97	5362.6
60.00	24	23.00	8428.01	7708.7
60.00	24	16.00	5862.97	5362.6

### 2.10.3 Water vapour measurements

Not applicable.

### 2.10.4 Manual monitoring method - results – calculations

**Wyndeham Heron  
PARTICULATE MATTER EMISSIONS TO ATMOSPHERE DATA (MDHS 14 METHOD)**

Date: 17/08/10

Site: Wyndeham Heron  
Atmospheric Press: 1008 mbar

Duct: **Compactor**

PARTICULATE MONITORING (MDHS-14)											
Duct Reference	Pump No.	Filter No.	Flow Start (l/min)	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 <sup>3</sup> )	
1	Compactor	6	93	2.00	2.00	2.00	12:24:00	16:30:00	04:06:00	246.00	0.49200
2	Compactor	31	74	2.00	0.00	1.00	12:27:00	16:30:00	04:03:00	243.00	0.24300
3	Compactor	27	76	2.00	1.00	1.50	12:31:00	16:30:00	03:59:00	239.00	0.35850
4	Compactor	8	62	2.00	0.00	1.00	12:34:00	16:30:00	03:56:00	236.00	0.23600

**2.9.5 Analysis results**

Filter Masses			Concn. Partic. Matter (mg/m <sup>3</sup> )	Corr. Part.Matt. Concn. (mg/Nm <sup>3</sup> )
Initial (mg)	Final (mg)	Difference (mg)		
24.44	25.04	0.60	1.22	<b>1.1154</b>
24.55	25.17	0.62	2.55	<b>2.3337</b>
24.65	25.41	0.76	2.12	<b>1.939</b>
25.19	25.74	0.55	2.33	<b>2.1316</b>

Max	2.33
Min	1.12
<b>Average =</b>	<b>1.88</b>

**2.9.6 Instrumental gas analyser site calibration measurements**

Not applicable.

**2.9.7 Instrumental gas analyser results**

Not applicable.

**2.10.8 Uncertainty calculations**

Not applicable.