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AIR QUALITY & ENVIRONMENTAL CONSULTANTS

Envirodat Limited, Science & Technology Centre,
Earley Gate, Whiteknights Road, Reading, RG6 6BZ
TEL: 01189 357 365 EMAIL: info@envirodat.org.uk
FAX: 01189 267 917 WEB: envirodat.org.uk

Report for the Periodic Monitoring of Emissions to Air from the Landfill Gas Engine and Flare Stacks Located at Hafod Quarry Landfill Site	MCERTS UKAS TESTING 4251
Part 1: **Executive Summary**	
Permit Number: EPR/PP3139GB	
Operator: Cory Environmental (Central) Ltd	
Installation: Hafod Quarry Landfill Site – Engine & Flare	

Monitoring dates:	19th September 2013
Job Number:	**R13156**
Version:	1
Address:	**Cory Environmental (Central) Ltd** 3-6 Greyfriars Business Park Frank Foley Way Stafford, ST16 2ST
Monitoring Organisation:	**EnviroDat Ltd.**
Address:	Science & Technology Centre Earley Gate Whiteknights Road Reading, RG6 6BZ
Date of Report:	3rd October 2013
Report Approved By:	Bruce Kester
MCERTS Registration Number:	MM03 190 (Level II, TE1, 2, 3 & 4)
Function:	Operations Manager (Team Leader)
Signed:	B. Kester

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PART 1: EXECUTIVE SUMMARY

1.1 Monitoring Objectives

Cory Environmental (Central) Ltd operates a spark ignition engine and a flare stack at Hafod Quarry Landfill Site. This combustion plant has the potential to pollute the atmosphere. Consequently, these processes are subject to regulation and periodic environmental monitoring is necessary under this regulation.

Methane is produced as a by-product of the decomposition of organic waste that is buried within the site (methanogenesis). This methane is extracted and pumped through inert piping to the engine or flare for combustion, the scale of which is dictated according to local engineering, operational requirements and methanogenic rate. The flare is designed to operate when excess gas is produced or during periods of engine maintenance.

EnviroDat Ltd. was commissioned to monitor the pollutants within the engine and flare emissions - as prescribed in the operational permit -in order to establish the sites environmental compliance.

The pollutants monitored, as required under EPR/PP3139GB, are summarised below:

Substances to be monitored	Emission Point Identification	
	Engine 923	Flare
Oxides of Nitrogen (NO_x as NO_2)	✓	✓
Carbon Monoxide (CO)	✓	✓
Total Volatile Organic Compounds (VOCs)	✓	✓
Oxygen (O_2. for correction)	✓	✓
Moisture (for correction)	✓	✓
Special requirements	None requested	

1.2 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Estimate of Uncertainty (2σ at 95% confidence)	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method (see note below)	Operating Status
Flare	Oxides of Nitrogen (as NO_2)	150	**75.4**	±8.3	$mg(N)m^{-3}$	101.3 kPa, 273K, dry gas, 3% O_2	19/09/13	12:03-13:03	BS EN 14792	A	At 30% capacity
	Carbon Monoxide	50	**17.7**	±3.6	$mg(N)m^{-3}$				BS EN 15058	A	
	Volatile Organic Compounds (VOCs as carbon)	10	**3.0**	±0.36	$mg(N)m^{-3}$				BS EN 12619	A	
	Moisture	-	**6.2**	n/a	%	101.3 kPa, 273K, dry gas			BS EN 14790	A	
	Oxygen	-	**14.45**	±0.69	%				BS EN 14789	A	

NOTE:

A. EnviroDat Ltd MCerts/UKAS Accredited for sampling and analysis.

B. EnviroDat Ltd Mcerts/UKAS Accredited for sampling only, UKAS Accredited analysis conducted by sub-contract laboratory.

C. EnviroDat Ltd UKAS Accredited for sampling only (further clarification is given in section 1.4). Analysis of this component is not UKAS Accredited.

D. The method for sampling and analysis is not UKAS or MCerts Accredited, method follows documented in-house procedure (further clarification is given in section 1.4).

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Estimate of Uncertainty (2σ at 95% confidence)	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method (see note below)	Operating Status
Engine 923	Oxides of Nitrogen (as NO_2)	500	**519.9**	±43	mg/m^3	101.3 kPa, 273K, dry gas, 5% O_2	19/09/13	14:35-15:35	BSEN 14792	A	At 75% capacity
	Carbon Monoxide	1400	**1,030.5**	±59	mg/m^3				BSEN 15058	A	
	Volatile Organic Compounds (VOCs as carbon)	1000	**1,739.9**	±82	mg/m^3				BSEN 12619	A	
	Oxygen	-	**7.04**	±0.42	%	101.3 kPa, 273K, dry gas			BSEN 14789	A	
	Moisture	-	**13.0**	n/a	%				BSEN 14790	A	

NOTE:

E. EnviroDat Ltd MCerts/UKAS Accredited for sampling and analysis.

F. EnviroDat Ltd Mcerts/UKAS Accredited for sampling only, UKAS Accredited analysis conducted by sub-contract laboratory.

G. EnviroDat Ltd UKAS Accredited for sampling only (further clarification is given in section 1.4). Analysis of this component is not UKAS Accredited.

H. The method for sampling and analysis is not UKAS or MCerts Accredited, method follows documented in-house procedure (further clarification is given in section 1.4).

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	Units
Flare	19/09/13	When required	N/A	Biogas	N/A	None	30% MCR (580m^3/hr on a 2000 m^3/hr)	N/A	N/A	N/A	N/A
Engine 923	19/09/13	Continuous	N/A	Biogas	N/A	None	75% MCR (850kWe on a 1136kWe unit)	N/A	N/A	N/A	N/A

1.4 Monitoring Deviations

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
Flare	None	None	None
Engine 923	None	None	None

PART 2: SUPPORTING INFORMATION

2.1 Appendix I: General Information

2.1.1 Monitoring organisation staff details

Monitoring at Hafod Quarry was conducted by the following EnviroDat Engineers:

Team Leader, Yu Shen – MM06 727 (Level II, TE1, 2, 3 & 4)

Team Leader, Bruce Kester - MM03 190 (Level II, TE1, 2, 3 & 4)

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, 101.3kPa, dry gas and 5% oxygen for engine emissions, 3% oxygen for flare.

2.1.2.2 NO_x (as NO_2)

A sample of the duct gas was passed via a short high temperature, stainless steel probe and down a heated PTFE line to a gas conditioner used to remove moisture. The conditioned (dry) gas then passed to a Horiba PG250 analyser, which, following specific pre-treatment of the NO_x within the sample, measured the concentration of NOx (as NO_2) by chemiluminescent detector, in accordance with EnviroDat Ltd. documented procedure SP14792, which implements the requirements of the standard reference method (SRM) BSEN14792. The detector and sampling system was checked prior to, and immediately following, testing to ensure operational conformity. This involved ensuring the absence of sample egress or air ingress, span and zero gas checks and system response times as necessary. All raw data was logged at 30-second intervals via a Grant Instruments Squirrel Datalogger and these are presented in Appendix II. An estimate of the uncertainty associated with the monitoring is also presented, as Appendix III.

2.1.2.3 CO

A sample of the duct gas was passed via a short high temperature, stainless steel probe and down a heated PTFE line to a gas conditioner used to remove moisture. The conditioned (dry) gas then passed to a Horiba PG250 analyser, which measured

the concentration of CO by non-dispersive infrared (NDIR) detector, in accordance with EnviroDat Ltd. documented procedure SP15058 which implements the requirements of the SRM BSEN15058. The detector and sampling system was checked prior to, and immediately following, testing to ensure operational conformity. This involved ensuring the absence of sample egress or air ingress, span and zero gas checks and system response times as necessary. All raw data was logged at 30-second intervals via a Grant Instruments Squirrel Datalogger and these raw data are presented in Appendix II. An estimate of the uncertainty associated with the monitoring is also presented, as Appendix III.

2.1.2.4 Total VOCs

VOC sampling was performed using a Signal 3010HM analyser that measures by use of a heated flame ionisation detector (FID) in accordance with SP12619, which implements the requirements of the SRM BSEN12619. The VOC analyser was positioned prior to the gas conditioner and measured the sample gas 'hot and wet.' The result was subsequently corrected to dry values. The detector and sampling system was checked prior to, and immediately following, testing to ensure operational conformity. This involved ensuring the absence of sample egress or air ingress, span and zero gas checks and system response times as necessary. All raw data was logged at 30-second intervals via a Grant Instruments Squirrel Datalogger and these raw data are presented in Appendix II. An estimate of the uncertainty associated with the monitoring is also presented, as Appendix III.

2.1.2.5 O_2

A sample of the duct gas was passed via a short high temperature, stainless steel probe and down a heated PTFE line to a gas conditioner used to remove moisture. The conditioned (dry) gas then passed to a Horiba PG250 analyser, which measured the concentration of O_2 by was measured by a zirconia cell, as detailed in documented procedure SP14789, which implements the requirements of the SRM BSEN14789. The detector and sampling system was checked prior to, and immediately following, testing to ensure operational conformity. This involved ensuring the absence of sample egress or air ingress, span and zero gas checks and system response times as necessary. All raw data was logged at 30-second intervals via a Grant Instruments Squirrel Datalogger and the raw data are presented in Appendix II. An estimate of the uncertainty associated with the monitoring is also presented, as Appendix III.

Determination of oxygen is essential for adjusting the prescribed pollutants to reference oxygen levels as detailed in the sites permit. This was performed in the following manner:

$$Conc_{ref} = Conc_{meas} \times \frac{(20.95-O_{2ref})}{(20.95-O_{2meas})}$$

Whereby, $Conc_{ref}$ was the concentration at reference conditions and $Conc_{meas}$ was the measured concentration, O_{2ref} is the oxygen reference conditions and O_{2meas} is the measured oxygen value.

2.1.2.6 Moisture

Moisture levels in the stack were determined gravimetrically to the requirements of BSEN14790, which implements the requirements of the SRM BSEN14790. The equipment consisted of an Apex Instruments USEPA Method Five apparatus. This consisted of a heated probe, heated filter and impinger bucket, connected to the sampling console. The console contained a calibrated dry gas meter. The data obtained from this system combined with the gravimetric increases allowed water content to be calculated. The moisture correction factor was calculated in the following manner:

$$\frac{(100-[H_2O]reference)}{(100-[H_2O]measured)}$$

This correction factor is only applied to the VOC result and was not applied to the combustion gases as the sample train for combustion gases uses a gas conditioner to remove moisture and introduces dried gas to the analyser. The raw data relating to the moisture test is presented as Appendix V.

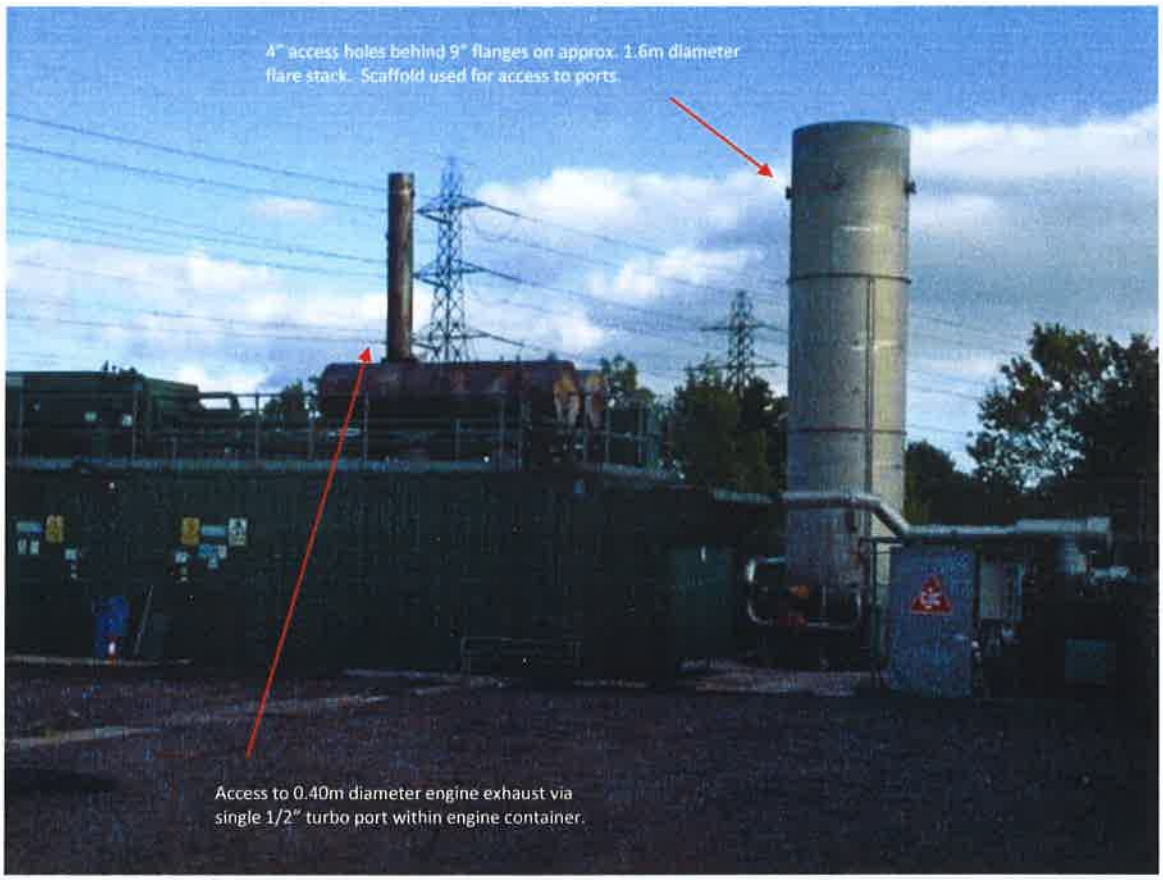
2.1.3 Monitoring organisation equipment and gas check list references

EQUIPMENT			
Item	**Reference**	**Calibration Due**	**PAT Due**
Portable Gas Analyser	PGA#02	24-Apr-14	Oct-13
Flame Ionisation Detector Analyser	FID#01	24-Apr-14	Oct-13
Gas Conditioner	COND#02	11-Feb-14	Oct-13
NO_x Convertor	CONV#02	02-Apr-14	Oct-13
Data Logger	DL#03	05-Nov-13	-
Digital Barometer	DB#08	01-Nov-14	-
Balance	BAL#02	14-Apr-14	-
Heated Line[1]	HL#07	28-Jan-14	-
Heated Line[2]	HL#08	28-Jan-14	-
Timepiece	TP#08	10-Jan-14	-
'Apex' Kit	APEX#02	See each item	See each item
Dry Gas Meter ('Apex')	DGM#05	24-Feb-14	-
Timepiece1 (Apex)	TP#09	01-Nov-13	-
Manometer ('Apex')	MAN#06 & 07	01-Nov-13	-
Thermocouple Reader	TCR#11	01-Nov-13	-
Thermocouple ('Apex' Dry Gas Meter)	TC#07	09-Oct-13	-

GAS CYLINDERS			
	Certificate No.	**Level (ppm)**	**Validity**
'Zero' Gas (%)	410534	99.9995	29-Jan-16
Oxygen Span Gas (%)	40-41509-002	10.03%	28-Feb-14
Carbon Monoxide Span Gas	49883	146.9	07-Jul-14
Carbon Monoxide Span Gas	3945/11	1603	20-Oct-13
Nitrogen Dioxide Span Gas	49883	85.3	07-Jul-14
Nitrogen Dioxide Span Gas	44512	980	20-Oct-13
VOC Span Gas	40-36910-001	11.68	18-Mar-14
VOC Span Gas	40-39637-001	553.7	19-Aug-14

2.2 Appendix II: Emission Point Reference Data & Results

2.2.1 Photo of Sampling Location on Engine & Flare Stacks



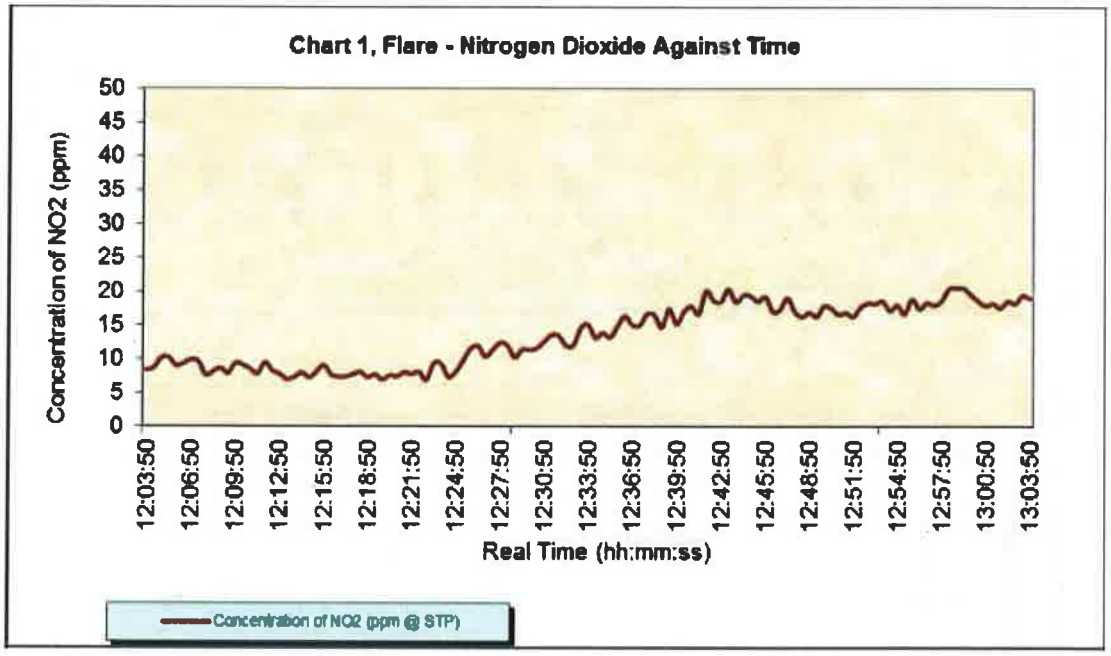
2.2.2 Homogeneity testing

BS EN 15259 stipulates that the exhaust gases emitted from combustion processes are tested to ensure homogeneity and that a representative sample is obtained during the monitoring, subject to a number of caveats as elucidated in Environment Agency guidance MID15259. The details of the testing at each emission point are summarised below:

Stack	Result of Homogeneity Testing
Flare	N/A – Due to health and safety implications of working on a live flare the homogeneity is assumed and single point sampling is adopted
Engine	N/A – homogeneity testing only required on stacks exceeding 1.13 m diameter, as specified in MID 15259. Homogeneity assumed and single point sampling acceptable.

2.2.3 Gas analyser site measurements and calibrations

The data in the following Charts 1 - 6 and Tables 1 & 2 are expressed ppm @ STP and is uncorrected for O_2. In Addition VOC results are expressed as methane equivalent. This data was subsequently converted from ppm to mg/m^3 and at reference oxygen concentrations (Section 1.2).



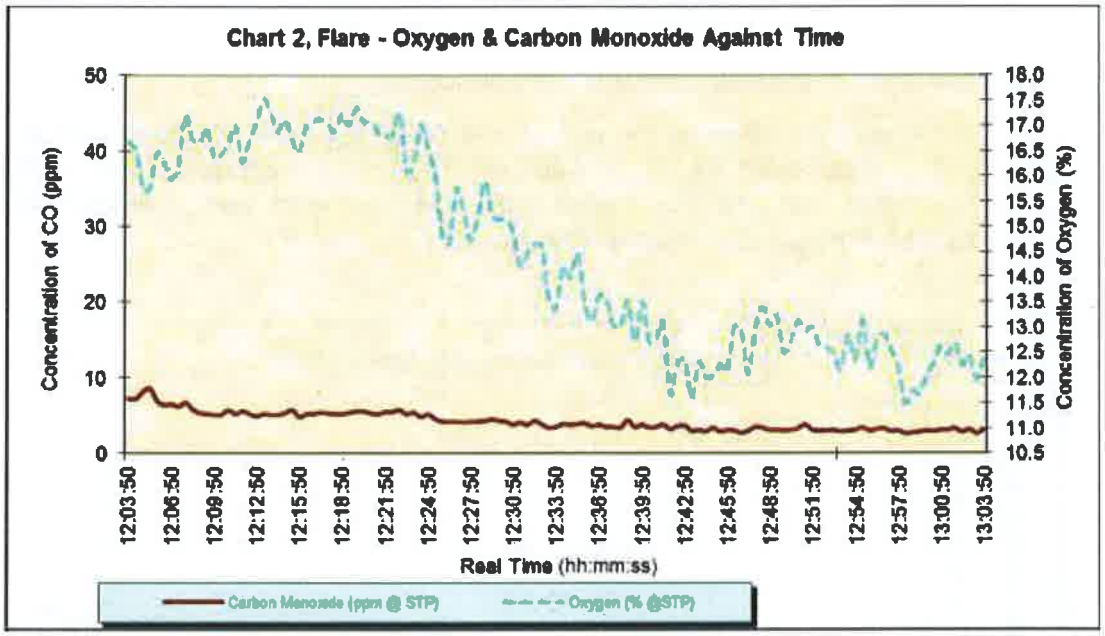


Chart 2, Flare - Oxygen & Carbon Monoxide Against Time
Concentration of CO (ppm)
Concentration of Oxygen (%)
Real Time (hh:mm:ss)
Carbon Monoxide (ppm @ STP)
Oxygen (% @STP)

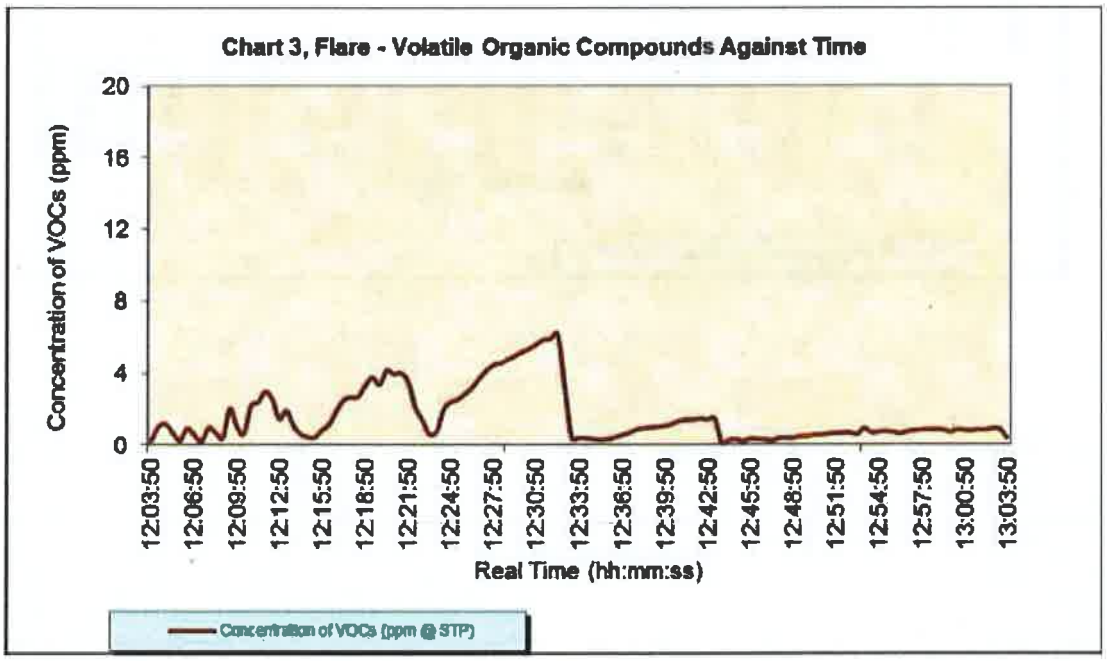


Chart 3, Flare - Volatile Organic Compounds Against Time
Concentration of VOCs (ppm)
Real Time (hh:mm:ss)
Concentration of VOCs (ppm @ STP)

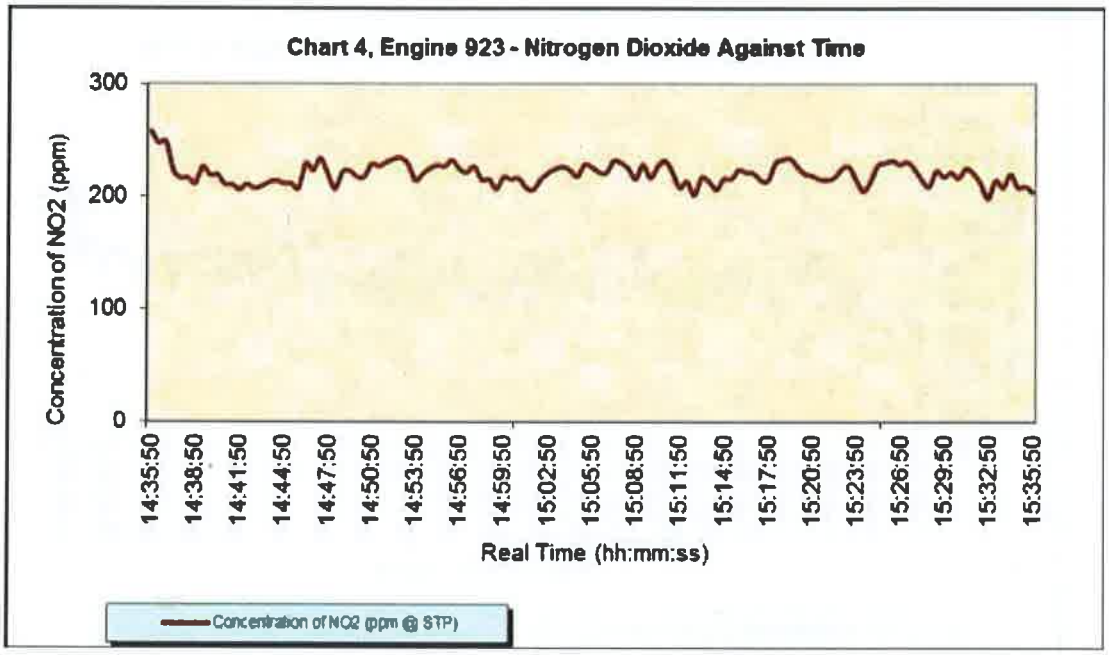


Chart 4, Engine 923 - Nitrogen Dioxide Against Time
Concentration of NO2 (ppm)
300
200
100
0
14:35:50
14:38:50
14:41:50
14:44:50
14:47:50
14:50:50
14:53:50
14:56:50
14:59:50
15:02:50
15:05:50
15:08:50
15:11:50
15:14:50
15:17:50
15:20:50
15:23:50
15:26:50
15:29:50
15:32:50
15:35:50
Real Time (hh:mm:ss)
Concentration of NO2 (ppm @ STP)

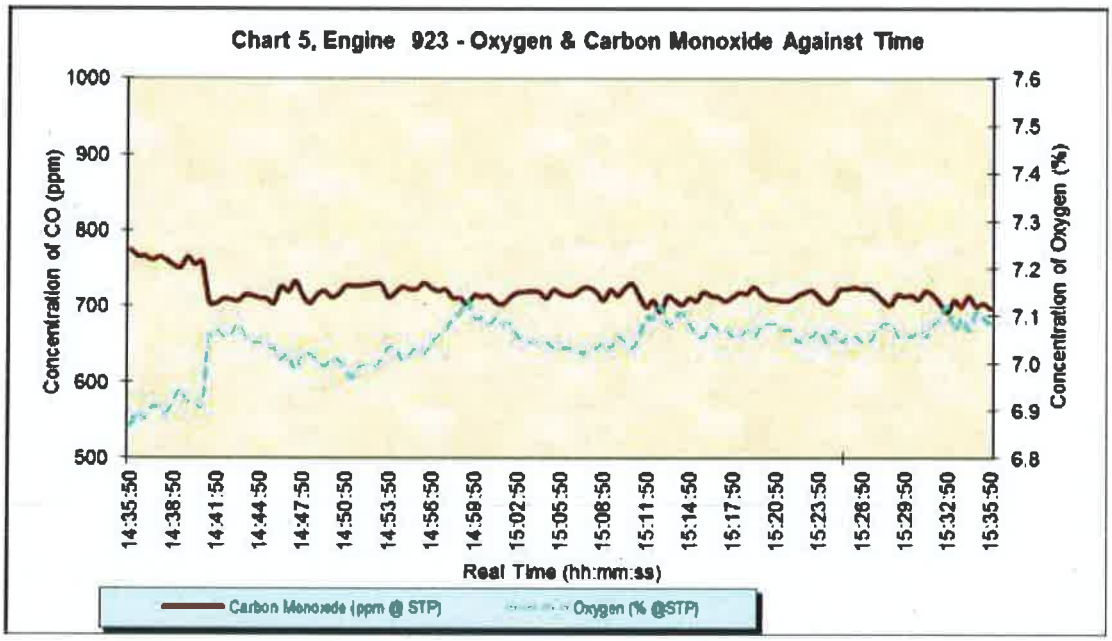


Chart 5, Engine 923 - Oxygen & Carbon Monoxide Against Time
Concentration of CO (ppm)
1000
900
800
700
600
500
Concentration of Oxygen (%)
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
14:35:50
14:38:50
14:41:50
14:44:50
14:47:50
14:50:50
14:53:50
14:56:50
14:59:50
15:02:50
15:05:50
15:08:50
15:11:50
15:14:50
15:17:50
15:20:50
15:23:50
15:26:50
15:29:50
15:32:50
15:35:50
Real Time (hh:mm:ss)
Carbon Monoxide (ppm @ STP)
Oxygen (% @STP)

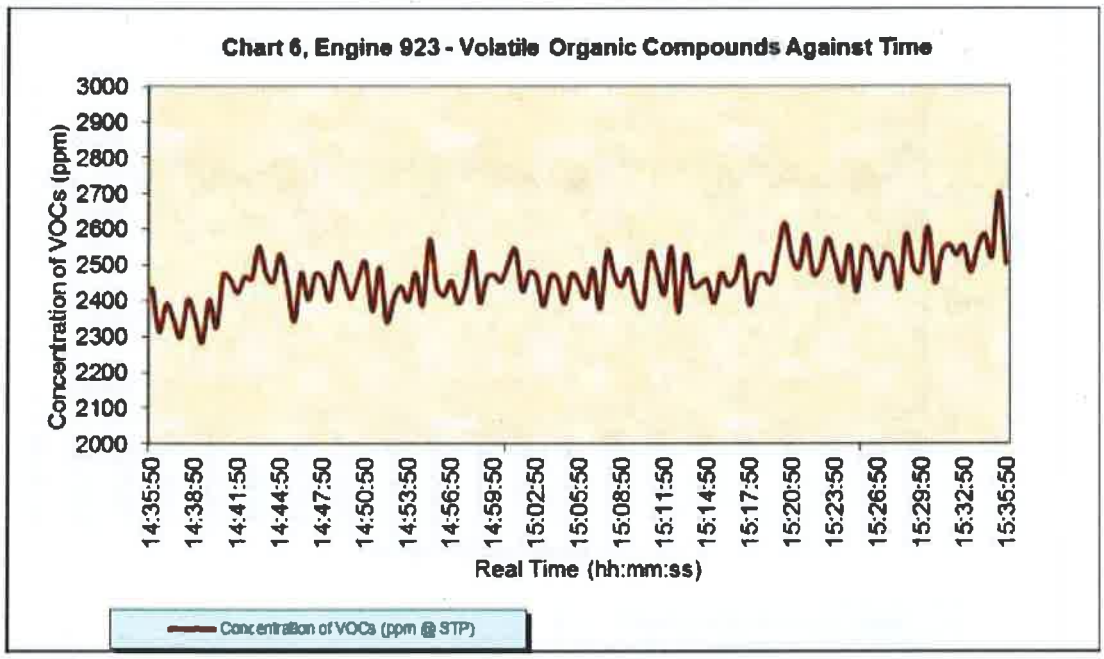


Chart 6, Engine 923 - Volatile Organic Compounds Against Time
Concentration of VOCs (ppm)
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
14:35:50
14:38:50
14:41:50
14:44:50
14:47:50
14:50:50
14:53:50
14:56:50
14:59:50
15:02:50
15:05:50
15:08:50
15:11:50
15:14:50
15:17:50
15:20:50
15:23:50
15:26:50
15:29:50
15:32:50
15:35:50
Real Time (hh:mm:ss)
Concentration of VOCs (ppm @ STP)

Table 1 – Flare, Raw Data

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
10:15:50	0.5	0.0	0.0	0.0	System Zero
10:16:20	0.3	0.0	0.4	0.0	
10:16:50	0.2	0.0	0.5	0.0	
10:17:20	0.1	0.0	0.3	0.0	
10:17:50	0.1	0.0	0.4	0.0	
10:18:20	0.1	0.0	0.1	0.0	
10:18:50	0.1	0.0	0.1	0.0	
10:19:20	0.0	0.0	0.2	0.0	
10:19:50	0.0	0.0	0.4	0.0	
10:20:20	4.1	0.0	0.4	0.0	
10:20:50	0.3	0.0	140.5	82.5	CO & NO span
10:21:20	0.1	0.0	143.1	84.9	
10:21:50	0.0	0.0	147.0	85.4	
10:22:20	0.0	0.0	146.3	85.4	
10:22:50	0.0	0.0	146.5	85.7	
10:23:20	12.2	0.1	60.1	38.1	
10:23:50	19.4	0.0	7.3	3.6	
10:24:20	9.9	0.1	3.1	1.4	O2 Span
10:24:50	9.9	0.0	1.5	0.7	
10:25:20	10.0	0.0	1.0	0.3	
10:25:50	12.8	26.8	0.8	0.4	
10:26:20	20.5	29.1	0.7	0.3	VOC span
10:26:50	20.7	34.7	0.6	0.2	
10:27:20	20.7	34.4	1.0	0.1	
10:27:50	20.8	35.7	1.3	0.1	
10:28:20	13.5	30.9	1.3	0.6	
10:28:50	0.5	2.1	0.7	0.1	Zero recheck
10:29:20	0.2	0.0	0.3	0.0	
10:29:50	0.1	0.1	0.3	0.1	
10:30:20	0.0	0.1	0.1	0.1	
10:30:50	18.4	0.1	1.9	0.5	
10:31:20	20.5	0.0	6.0	1.6	
10:31:50	12.0	0.0	2.8	1.3	
10:32:20	1.2	0.0	1.0	0.3	Zero downline & repeatablility
10:32:50	0.3	0.0	0.8	0.3	
10:33:20	0.2	0.0	1.1	0.2	
10:33:50	0.1	0.0	1.0	0.2	
10:34:20	0.1	0.0	1.0	0.2	
10:34:50	0.2	0.0	1.3	0.2	
10:35:20	0.1	0.0	1.5	0.2	
10:35:50	1.2	0.1	97.8	55.2	
10:36:20	0.1	0.1	144.3	87.5	CO & NOX downline & response
10:36:50	0.0	0.0	146.1	85.7	
10:37:20	0.2	0.0	61.5	27.5	
10:37:50	0.1	0.1	72.5	66.0	

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
10:38:20	1.9	0.0	140.4	83.0	
10:38:50	13.1	0.0	13.1	8.6	
10:39:20	10.1	0.0	2.8	1.3	O2 downline & response
10:39:50	10.0	0.0	2.5	0.7	
10:40:20	10.0	1.0	1.9	0.7	
10:40:50	10.0	33.6	1.7	0.4	VOC downline & response
10:41:20	18.4	34.2	1.9	0.5	
10:41:50	20.4	32.7	1.8	0.3	
10:42:20	20.6	3.6	1.6	0.3	
10:42:50	20.6	5.6	1.8	0.4	
12:02:50	16.8	1.2	7.9	7.9	
12:03:20	16.9	0.7	7.9	7.7	
12:03:50	16.7	0.2	7.2	8.3	Flare Test Start
12:04:20	16.5	1.0	7.2	8.7	
12:04:50	15.7	1.1	8.1	10.1	
12:05:20	15.8	0.6	8.6	10.3	
12:05:50	16.5	0.2	6.9	9.0	
12:06:20	16.3	0.9	6.4	9.3	
12:06:50	15.9	0.5	6.5	9.9	
12:07:20	16.2	0.2	6.2	9.6	
12:07:50	17.2	0.9	6.7	7.6	
12:08:20	16.7	0.7	5.8	8.1	
12:08:50	16.7	0.4	5.3	8.6	
12:09:20	17.0	2.0	5.2	7.9	
12:09:50	16.4	1.0	5.1	9.4	
12:10:20	16.4	0.6	5.1	9.1	
12:10:50	16.6	2.2	5.7	8.5	
12:11:20	17.0	2.4	5.2	7.8	
12:11:50	16.3	3.0	5.6	9.5	
12:12:20	16.7	2.5	5.2	8.3	
12:12:50	17.0	1.4	4.9	7.8	
12:13:20	17.5	1.9	5.2	7.0	
12:13:50	17.3	1.0	5.1	7.3	
12:14:20	16.9	0.6	5.1	8.0	
12:14:50	17.1	0.4	5.3	7.2	
12:15:20	16.7	0.4	5.8	8.1	
12:15:50	16.5	0.8	4.8	9.1	
12:16:20	17.0	1.1	5.2	7.7	
12:16:50	17.1	1.9	5.2	7.4	
12:17:20	17.1	2.5	5.4	7.4	
12:17:50	17.0	2.6	5.3	7.7	
12:18:20	16.9	2.7	5.2	8.1	
12:18:50	17.2	3.3	5.2	7.3	
12:19:20	17.0	3.8	5.4	7.7	
12:19:50	17.4	3.3	5.6	6.9	
12:20:20	17.1	4.1	5.6	7.6	

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
12:20:50	17.1	3.9	5.3	7.4	
12:21:20	16.8	4.0	5.2	8.1	
12:21:50	16.8	3.5	5.5	7.8	
12:22:20	16.8	2.1	5.5	8.1	
12:22:50	17.3	1.4	5.8	6.9	
12:23:20	16.1	0.6	5.2	9.4	
12:23:50	16.2	0.7	5.4	9.3	
12:24:20	17.0	2.0	4.8	7.3	
12:24:50	16.5	2.4	5.2	8.1	
12:25:20	16.0	2.5	4.6	9.8	
12:25:50	14.8	2.8	4.2	11.5	
12:26:20	14.7	3.2	4.2	11.9	
12:26:50	15.8	3.7	4.2	10.4	
12:27:20	15.3	4.1	4.1	11.4	
12:27:50	14.7	4.4	4.2	12.4	
12:28:20	15.2	4.5	4.2	12.0	
12:28:50	15.9	4.7	4.3	10.2	
12:29:20	15.2	4.9	4.5	11.4	
12:29:50	15.1	5.2	4.3	11.3	
12:30:20	15.1	5.3	4.2	11.6	
12:30:50	14.9	5.6	3.8	12.6	
12:31:20	14.2	5.8	4.1	13.6	
12:31:50	14.5	5.9	3.8	13.4	
12:32:20	14.7	6.2	4.3	12.0	
12:32:50	14.6	3.3	3.9	12.1	
12:33:20	13.6	0.4	3.4	14.6	
12:33:50	13.4	0.4	3.5	15.1	
12:34:20	14.2	0.4	3.9	13.1	
12:34:50	14.0	0.3	3.8	13.9	
12:35:20	14.5	0.3	3.9	13.2	
12:35:50	13.5	0.3	4.0	14.9	
12:36:20	13.1	0.4	3.6	16.4	
12:36:50	13.6	0.5	3.8	15.1	
12:37:20	13.6	0.7	3.5	15.0	
12:37:50	13.1	0.8	3.5	16.7	
12:38:20	13.0	0.9	3.4	16.5	
12:38:50	13.5	1.0	4.4	14.7	
12:39:20	12.7	1.0	3.5	17.4	
12:39:50	13.5	1.0	3.8	15.2	
12:40:20	12.7	1.1	3.4	17.0	
12:40:50	12.8	1.3	3.5	17.9	
12:41:20	13.1	1.4	3.8	16.7	
12:41:50	11.7	1.4	3.2	20.1	
12:42:20	12.3	1.5	3.6	18.7	
12:42:50	12.4	1.4	3.7	18.5	
12:43:20	11.6	1.5	3.0	20.4	

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
12:43:50	12.3	0.1	3.1	18.4	
12:44:20	12.0	0.2	2.9	19.5	
12:44:50	12.0	0.3	3.4	19.4	
12:45:20	12.3	0.2	2.9	18.5	
12:45:50	12.1	0.3	3.1	19.3	
12:46:20	13.0	0.3	3.0	17.1	
12:46:50	12.9	0.3	2.7	17.4	
12:47:20	12.1	0.2	3.0	19.1	
12:47:50	13.0	0.4	3.5	17.0	
12:48:20	13.4	0.4	3.4	16.3	
12:48:50	13.0	0.4	3.1	16.9	
12:49:20	13.2	0.4	3.1	16.3	
12:49:50	12.5	0.5	3.0	17.9	
12:50:20	12.7	0.5	3.1	17.5	
12:50:50	13.1	0.5	3.3	16.6	
12:51:20	12.9	0.6	3.8	16.9	
12:51:50	13.0	0.6	3.1	16.3	
12:52:20	12.6	0.7	3.0	17.6	
12:52:50	12.6	0.7	3.0	18.3	
12:53:20	12.5	0.6	3.1	18.2	
12:53:50	12.2	0.9	2.9	18.6	
12:54:20	12.8	0.7	3.0	17.2	
12:54:50	12.4	0.7	3.1	18.0	
12:55:20	13.1	0.7	3.4	16.7	
12:55:50	12.2	0.7	3.0	18.9	
12:56:20	12.7	0.6	3.2	17.4	
12:56:50	12.9	0.7	3.3	18.4	
12:57:20	12.6	0.8	2.9	18.0	
12:57:50	12.2	0.8	3.0	18.6	
12:58:20	11.5	0.8	2.6	20.4	
12:58:50	11.7	0.8	2.7	20.6	
12:59:20	11.7	0.8	2.8	20.5	
12:59:50	12.0	0.7	3.0	19.5	
13:00:20	12.3	0.8	2.9	18.6	
13:00:50	12.6	0.8	3.1	17.9	
13:01:20	12.5	0.8	3.1	18.2	
13:01:50	12.7	0.8	3.3	17.6	
13:02:20	12.2	0.8	2.8	18.6	
13:02:50	12.4	0.9	3.2	18.2	
13:03:20	12.0	0.9	2.6	19.5	
13:03:50	12.4	0.4	3.1	19.0	Flare Test Finish
13:04:20	16.9	0.0	24.8	9.6	
13:04:50	20.2	0.0	7.7	1.1	
13:13:50	20.8	2.4	2.1	0.1	
13:14:20	20.8	1.9	2.5	0.0	
13:14:50	8.4	2.2	2.2	0.1	

Job Number: R13156

Client Name: Cory Environmental (Central) Ltd

enviroDAT

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
13:15:20	1.1	2.3	1.5	0.1	
13:15:50	0.4	2.3	1.4	0.0	
13:16:20	0.2	2.4	1.4	0.0	
13:16:50	0.2	2.4	1.3	0.0	
13:17:20	0.1	2.5	1.1	0.0	
13:17:50	0.1	2.5	1.4	0.0	
13:18:20	0.1	2.5	1.1	0.1	zero drift check
13:18:50	0.1	0.0	1.2	0.0	
13:19:20	0.1	0.0	1.4	0.0	
13:19:50	0.1	0.0	1.2	0.0	
13:20:20	0.1	0.0	1.6	0.1	
13:20:50	0.1	0.0	133.2	74.1	
13:21:20	0.0	0.0	145.5	82.8	CO & NOx span drift check
13:21:50	0.0	0.0	146.4	85.3	
13:22:20	0.1	0.0	145.7	84.5	
13:22:50	0.0	0.0	147.4	85.0	
13:23:20	3.8	0.0	112.9	69.7	
13:23:50	9.4	0.0	8.7	5.1	
13:24:20	9.9	0.0	3.0	1.2	
13:24:50	9.9	0.0	2.5	0.7	O2 span drift check
13:25:20	10.0	0.0	2.1	0.5	
13:25:50	10.0	0.0	1.6	0.5	
13:26:20	10.0	34.9	1.7	0.3	VOC span drift check
13:26:50	17.5	34.9	1.8	0.4	
13:27:20	19.6	33.0	0.6	0.1	

Table 2 – Engine 923, Raw Data

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
13:32:20	0.4	0.6	0.6	0.3	System Zero
13:32:50	0.2	0.9	0.6	0.3	
13:33:20	0.1	1.2	0.6	0.4	
13:33:50	0.0	1.5	0.6	0.4	
13:34:20	0.0	1.8	0.6	0.4	
13:34:50	0.0	1.5	0.6	0.4	
13:35:20	0.0	0.9	0.6	0.4	
13:35:50	0.0	1.2	0.6	0.4	
13:36:20	1.9	1.2	0.6	641.9	
13:36:50	0.1	0.9	0.6	925.8	NO Span
13:37:20	0.0	0.9	0.6	935.9	
13:37:50	0.0	0.9	0.6	938.9	
13:38:20	0.0	0.6	0.6	941.0	
13:38:50	0.0	0.9	0.6	980.5	
13:39:20	0.0	0.9	0.6	980.5	
13:39:50	15.5	1.2	0.6	206.6	
13:40:20	19.5	1555.2	0.6	42.9	VOC span
13:40:50	19.9	1663.2	0.6	32.9	
13:41:20	20.1	1659.0	0.6	29.3	
13:41:50	10.0	2.1	0.6	58.8	
13:42:20	10.1	1.8	0.6	8.9	
13:42:50	10.1	1.5	0.6	4.4	O2 Span
13:43:20	10.1	1.8	0.6	3.3	
13:43:50	10.1	1.5	0.6	2.9	
13:44:20	10.1	1.5	0.6	2.3	
13:44:50	10.0	1.2	0.6	1.9	
13:45:20	10.3	1.2	0.6	1.9	
13:45:50	1.0	1.8	1560.6	4.5	CO Span
13:46:20	0.2	1.8	1594.8	1.9	
13:46:50	0.0	2.1	1605.8	1.3	
13:47:20	0.0	1.5	1609.8	0.9	
13:47:50	0.1	0.9	31.8	1.3	zero recheck
13:48:20	0.0	0.9	15.6	0.9	
13:48:50	0.0	1.2	9.6	0.9	
13:49:20	0.0	0.9	6.6	0.9	
13:49:50	19.7	0.9	6.6	0.9	
13:50:20	20.5	0.6	11.6	1.3	
13:50:50	20.7	0.0	7.8	0.9	
13:51:20	6.1	0.0	10.8	1.3	
13:51:50	0.8	0.0	4.6	0.4	Zero downline
13:52:20	0.3	0.0	3.6	0.4	
13:52:50	0.2	0.0	3.6	0.4	
13:53:20	0.1	0.0	3.6	0.4	
13:53:50	0.2	1.5	3.6	0.4	
13:54:20	0.3	0.0	2.6	0.4	

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
13:54:50	0.6	0.0	1414.2	0.4	CO downline & response
13:55:20	0.0	0.0	1599.8	0.4	
13:55:50	0.0	0.0	1612.6	0.4	
13:56:20	0.0	0.0	1610.6	0.4	
13:56:50	0.1	0.0	1619.8	0.4	
13:57:20	9.8	0.0	182.0	0.4	
13:57:50	9.8	0.0	23.8	0.3	O2 downline & response
13:58:20	9.9	0.0	12.6	0.4	
13:58:50	9.9	0.0	10.6	0.3	
13:59:20	10.0	0.0	8.6	0.4	
13:59:50	10.0	0.0	7.6	0.4	
14:00:20	10.0	0.0	6.6	0.4	
14:00:50	1.8	0.0	9.8	791.2	
14:01:20	0.4	0.0	5.6	948.3	NO downline & response
14:01:50	0.2	0.0	4.6	960.5	
14:02:20	0.1	0.0	4.6	964.5	
14:02:50	0.3	0.0	0.6	88.2	
14:03:20	0.1	1641.3	4.6	968.8	VOC downline & response
14:03:50	10.8	1599.9	28.4	473.6	
14:04:20	19.5	106.2	10.6	35.1	
14:04:50	20.1	4.8	9.6	8.9	
14:05:20	20.4	2.1	4.6	6.4	
14:05:50	20.6	1.5	4.6	4.9	
14:35:20	6.9	2334.9	766.8	258.9	Sampling From Engine 923
14:35:50	6.9	2435.4	773.8	257.9	
14:36:20	6.9	2313.6	765.8	247.4	
14:36:50	6.9	2391.3	765.8	248.9	
14:37:20	6.9	2346.0	760.8	222.9	
14:37:50	6.9	2297.7	764.8	216.4	
14:38:20	6.9	2403.0	760.8	216.5	
14:38:50	6.9	2351.1	753.8	211.4	
14:39:20	6.9	2283.3	750.8	226.4	
14:39:50	6.9	2402.7	764.8	218.8	
14:40:20	6.9	2324.4	754.8	219.4	
14:40:50	6.9	2474.1	757.8	210.9	
14:41:20	7.1	2458.2	704.8	210.5	
14:41:50	7.1	2421.6	703.8	206.0	
14:42:20	7.1	2466.3	709.8	210.9	
14:42:50	7.1	2461.5	708.8	207.3	
14:43:20	7.1	2552.1	706.8	209.0	
14:43:50	7.1	2475.3	714.8	212.5	
14:44:20	7.0	2453.4	713.8	213.9	
14:44:50	7.0	2530.2	710.8	211.4	
14:45:20	7.0	2448.0	709.8	211.5	
14:45:50	7.0	2342.7	703.8	207.3	
14:46:20	7.0	2478.3	725.8	229.3	

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
14:46:50	7.0	2402.1	718.8	222.9	
14:47:20	7.0	2474.7	732.8	233.9	
14:47:50	7.0	2463.9	713.8	220.5	
14:48:20	7.0	2401.2	703.8	206.8	
14:48:50	7.0	2504.7	714.8	221.9	
14:49:20	7.0	2465.1	719.8	222.9	
14:49:50	7.0	2405.7	711.8	217.5	
14:50:20	7.0	2462.4	715.8	217.3	
14:50:50	7.0	2507.7	726.8	228.9	
14:51:20	7.0	2371.2	726.6	226.8	
14:51:50	7.0	2493.6	726.8	230.4	
14:52:20	7.0	2341.2	727.8	233.4	
14:52:50	7.0	2408.7	729.8	234.4	
14:53:20	7.0	2439.3	728.8	228.9	
14:53:50	7.0	2399.7	711.8	214.5	
14:54:20	7.0	2478.9	717.8	220.3	
14:54:50	7.0	2388.0	725.8	225.3	
14:55:20	7.0	2571.6	721.8	227.9	
14:55:50	7.0	2436.0	722.8	226.9	
14:56:20	7.0	2414.4	730.8	232.4	
14:56:50	7.0	2455.5	723.8	224.4	
14:57:20	7.1	2393.4	719.8	221.5	
14:57:50	7.1	2438.4	721.8	226.9	
14:58:20	7.1	2536.8	710.6	214.9	
14:58:50	7.1	2395.8	710.8	215.5	
14:59:20	7.1	2464.8	702.8	206.9	
14:59:50	7.1	2471.7	714.6	217.4	
15:00:20	7.1	2454.0	711.8	215.4	
15:00:50	7.1	2502.0	713.8	216.4	
15:01:20	7.1	2543.7	704.8	208.0	
15:01:50	7.1	2427.9	702.8	206.0	
15:02:20	7.1	2480.4	711.8	214.9	
15:02:50	7.1	2468.7	717.8	220.9	
15:03:20	7.0	2385.6	718.8	224.4	
15:03:50	7.0	2468.7	719.8	226.4	
15:04:20	7.0	2461.5	718.8	223.4	
15:04:50	7.0	2393.7	710.6	217.9	
15:05:20	7.0	2475.3	721.8	228.5	
15:05:50	7.0	2450.7	716.8	226.0	
15:06:20	7.0	2408.4	713.8	221.4	
15:06:50	7.0	2489.4	715.8	221.3	
15:07:20	7.0	2378.1	723.8	231.9	
15:07:50	7.0	2539.5	724.8	229.9	
15:08:20	7.0	2472.0	718.8	225.0	
15:08:50	7.0	2440.5	707.8	215.5	
15:09:20	7.0	2491.2	721.8	228.3	

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
15:09:50	7.1	2411.4	713.8	216.4	
15:10:20	7.0	2383.5	723.8	226.4	
15:10:50	7.0	2534.4	729.8	231.8	
15:11:20	7.1	2484.0	714.6	222.0	
15:11:50	7.1	2418.0	698.8	208.0	
15:12:20	7.1	2548.8	707.6	213.4	
15:12:50	7.1	2366.7	692.6	201.4	
15:13:20	7.1	2527.8	712.8	216.9	
15:13:50	7.1	2439.3	707.8	213.4	
15:14:20	7.1	2445.9	701.8	206.4	
15:14:50	7.1	2457.9	710.8	215.9	
15:15:20	7.1	2394.3	706.8	215.5	
15:15:50	7.1	2476.2	718.8	223.8	
15:16:20	7.1	2441.7	713.8	221.4	
15:16:50	7.1	2461.5	712.6	220.9	zero drift check
15:17:20	7.1	2523.0	706.8	214.4	
15:17:50	7.1	2387.7	711.8	214.3	
15:18:20	7.1	2466.6	717.8	229.9	
15:18:50	7.1	2475.6	716.8	232.9	
15:19:20	7.1	2449.5	725.8	233.9	O2 span drift check
15:19:50	7.1	2538.6	715.8	226.5	
15:20:20	7.1	2616.6	709.8	220.4	
15:20:50	7.1	2519.7	708.8	218.5	
15:21:20	7.1	2491.8	706.8	215.5	
15:21:50	7.1	2583.6	707.8	214.9	CO & NOx span drift check
15:22:20	7.0	2475.0	713.8	216.9	
15:22:50	7.1	2492.7	717.8	224.4	
15:23:20	7.1	2573.7	720.8	226.9	VOC span drift check
15:23:50	7.1	2516.7	712.8	215.0	
15:24:20	7.0	2452.8	703.8	204.9	
15:24:50	7.1	2553.9	707.8	213.9	
15:25:20	7.0	2424.9	721.8	227.9	
15:25:50	7.1	2547.6	722.8	229.8	
15:26:20	7.1	2532.9	724.8	232.0	
15:26:50	7.0	2458.8	722.6	228.3	
15:27:20	7.0	2529.0	722.8	230.9	
15:27:50	7.1	2516.1	716.8	224.4	
15:28:20	7.1	2433.3	707.8	214.9	
15:28:50	7.1	2586.6	700.8	208.8	
15:29:20	7.1	2490.3	714.6	222.9	
15:29:50	7.1	2480.4	712.8	217.4	
15:30:20	7.1	2606.1	713.8	221.5	
15:30:50	7.1	2450.4	708.8	216.4	
15:31:20	7.1	2537.7	719.8	224.9	
15:31:50	7.1	2556.6	714.8	220.8	
15:32:20	7.1	2527.2	703.8	211.6	

Time	Oxygen (%)	VOC (ppm)	CO (ppm)	Nox (ppm)	Comment
15:32:50	7.1	2554.8	691.8	198.4	
15:33:20	7.1	2479.5	707.8	214.4	
15:33:50	7.1	2550.6	698.8	207.9	
15:34:20	7.1	2585.7	712.8	219.8	
15:34:50	7.1	2523.3	699.8	208.4	
15:35:20	7.1	2704.2	703.8	209.4	Sampling Finish on Engine 923
15:35:50	7.1	2504.1	696.8	203.9	
15:36:20	7.1	1740.9	698.6	203.8	
15:36:50	7.1	26.4	702.8	208.9	
15:37:20	18.4	32.4	108.8	70.2	
15:37:50	20.2	9.6	26.6	40.4	
15:38:20	20.5	4.8	16.6	34.9	
15:38:50	20.6	3.9	13.8	32.4	
15:39:20	20.6	3.6	12.6	25.6	
15:39:50	20.6	6.9	11.8	10.3	
15:40:20	20.3	0.0	10.6	7.9	
15:40:50	2.8	0.0	8.6	7.9	
15:41:20	0.5	0.0	7.8	7.4	
15:41:50	0.3	0.0	7.8	6.9	zero drift check
15:42:20	0.2	0.0	6.6	6.4	
15:42:50	0.1	0.0	6.6	5.9	
15:43:20	0.2	0.0	7.8	5.4	
15:43:50	0.2	0.9	8.6	6.4	
15:44:20	0.1	0.0	6.6	5.4	
15:44:50	7.4	0.0	6.6	400.0	NO span drift check
15:45:20	0.7	0.0	5.8	924.9	
15:45:50	0.2	0.0	5.8	964.5	
15:46:20	0.2	0.3	6.6	969.1	
15:46:50	0.1	1672.5	5.6	972.9	VOC span drift check
15:47:20	4.2	1666.5	7.6	827.3	
15:47:50	19.1	24.3	11.8	50.9	
15:48:20	19.4	2.4	10.6	13.8	
15:48:50	10.7	0.3	6.6	9.9	O2 span drift check
15:49:20	10.1	0.0	4.8	6.9	
15:49:50	10.0	0.0	4.6	5.9	
15:50:20	10.0	0.0	5.8	5.9	
15:50:50	10.0	0.0	4.6	4.4	
15:51:50	0.5	2.1	1570.6	4.4	
15:52:20	16.8	1.2	257.2	3.9	
15:52:50	20.2	0.0	22.8	3.3	
15:53:20	12.0	0.0	779.2	2.9	
15:53:50	1.2	0.0	1558.6	2.9	CO span drift check
15:54:20	0.2	0.0	1618.8	2.9	
15:54:50	0.1	0.0	1623.8	2.4	
15:55:20	0.1	1.2	1621.8	3.3	
15:55:50	0.4	1.2	1623.0	2.4	

2.3 Appendix III: Uncertainty Calculation

2.3.1 Flare

Nox - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.80
Standard deviation of repeatability at span level	u_{rs}	0.07
Lack of fit	u_{fit}	0.95
Drift	u_{0dr}	2.80
volume or pressure flow dependence	u_{spres}	0.02
atmopsheric pressure dependence	u_{apres}	2.37
ambient temperature dependence	u_{temp}	0.46
NH3 (20 mg/m3)	u_{interf}	0.14
CO2 (15%)	-	0.02
H2O (30%)	-	0.01
Error in logger voltage	-	1.00
Dependence on voltage	u_{volt}	0.03
Converter efficiency	u_{ceff}	0.35
losses in the line (leak)	u_{leak}	0.87
Uncertainty of calibration gas	u_{calib}	0.87

Nox Measurement uncertainty		Result	75.40	mg/m^3
Combined uncertainty			4.15	mg/m^3
Expanded uncertainty	k = 2		8.30	mg/m^3
Uncertainty corrected to std conds			8.30	mg.m-3 (corrected)
Expanded uncertainty	**expressed with a level of confidence of 95%**		**5.54 % ELV**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**8.30 mg.m^{-3} of result**	

CO - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.80
Standard deviation of repeatability at span level	u_{rs}	0.07
Lack of fit	u_{fit}	0.58
Drift	u_{0dr}	1.55
volume or pressure flow dependence	u_{spres}	0.00
atmopsheric pressure dependence	u_{apres}	0.58
ambient temperature dependence	u_{temp}	0.00
CO2 (15%)	u_{interf}	0.00
N2O (40mgm3)	-	0.00
CH4 (57mgm3)	-	0.00
H2O (1%)	-	0.00
Dependence on voltage	u_{volt}	0.03
Error in Logger reading	-	0.20
losses in the line (leak)	u_{leak}	0.20
Uncertainty of calibration gas	u_{calib}	0.20

CO Measurement uncertainty		Result	17.70	mg/m^3
Combined uncertainty			1.78	mg/m^3
Expanded uncertainty	k = 2		3.57	mg/m^3
Uncertainty corrected to std conds			3.57	mg.m-3 (corrected)
Expanded uncertainty	**expressed with a level of confidence of 95%**		**3.57 % ELV**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**3.57 mg.m^{-3} of result**	

VOC - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.80
Standard deviation of repeatability at span level	u_{rs}	0.07
Lack of fit	u_{fit}	0.04
Drift	u_{0dr}	0.11
volume or pressure flow dependence	u_{spres}	0.00
atmopsheric pressure dependence	u_{apres}	0.07
ambient temperature dependence	u_{temp}	0.00
NH3 (20 mg/m3)	u_{intrf}	0.00
CO2 (15%)	-	0.00
H2O (30%)	-	0.00
Error on Logger voltage	-	0.01
Dependence on voltage	u_{volt}	0.03
losses in the line (leak)	u_{leak}	0.03
Uncertainty of calibration gas	u_{calib}	0.03

VOC Measurement uncertainty		Result	3.00	mg/m^3
Combined uncertainty			0.17	mg/m^3
Expanded uncertainty	k = 2		0.34	mg/m^3
Uncertainty corrected to std conds			0.36	mg.m-3 (corrected)
Expanded uncertainty	**expressed with a level of confidence of 95%**		**3.58 % ELV**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**0.36 $mg.m^{-3}$ of result**	

Oxygen - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.20
Standard deviation of repeatability at span level	u_{rs}	0.02
Lack of fit	u_{fit}	0.17
Drift	u_{0dr}	0.14
volume or pressure flow dependence	u_{spres}	0.00
atmopsheric pressure dependence	u_{apres}	0.07
ambient temperature dependence	u_{temp}	0.07
CO2 (15%)	-	0.00
NO(300)	-	0.06
NO2(30)	-	0.00
dependence on voltage	u_{volt}	0.02
losses in the line (leak)	u_{leak}	0.17
Error in Logger voltage	-	0.03
Uncertainty of calibration gas	u_{calib}	0.17

O2 Measurement uncertainty		Result	14.45	%vol
Combined uncertainty			0.34	%vol
% of value			2.38	%
Expanded uncertainty	**expressed with a level of confidence of 95%**		**4.77 % of value**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**0.69 % vol**	

2.3.2 Flare

Nox - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.80
Standard deviation of repeatability at span level	u_{rs}	0.07
Lack of fit	u_{rl}	4.73
Drift	u_{0dr}	14.84
volume or pressure flow dependence	u_{spres}	0.12
atmopsheric pressure dependence	u_{apres}	11.84
ambient temperature dependence	u_{temp}	0.46
NH3 (20 mg/m3)	u_{interf}	0.14
CO2 (15%)	-	0.02
H2O (30%)	-	0.01
Error in logger voltage	-	1.00
Dependence on voltage	u_{volt}	0.03
Converter efficiency	u_{ceff}	2.40
losses in the line (leak)	u_{leak}	6.00
Uncertainty of calibration gas	u_{calib}	6.00

Nox Measurement uncertainty		Result	519.90	mg/m^3
Combined uncertainty			21.49	mg/m^3
Expanded uncertainty	k = 2		42.98	mg/m^3
Uncertainty corrected to std conds			42.98	mg.m-3 (corrected)
Expanded uncertainty	**expressed with a level of confidence of 95%**		**8.60 % ELV**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**42.98 mg.m^{-3} of result**	

CO - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.80
Standard deviation of repeatability at span level	u_{rs}	0.07
Lack of fit	u_{rl}	5.77
Drift	u_{0dr}	20.38
volume or pressure flow dependence	u_{spres}	0.00
atmopsheric pressure dependence	u_{apres}	11.55
ambient temperature dependence	u_{temp}	0.00
CO2 (15%)	u_{interf}	0.00
N2O (40mgm3)	-	0.00
CH4 (57mgm3)	-	0.00
H2O (1%)	-	0.00
Dependence on voltage	u_{volt}	0.03
Error in Logger reading	-	2.00
losses in the line (leak)	u_{leak}	11.90
Uncertainty of calibration gas	u_{calib}	11.90

CO Measurement uncertainty		Result	1030.50	mg/m^3
Combined uncertainty			29.48	mg/m^3
Expanded uncertainty	k = 2		58.97	mg/m^3
Uncertainty corrected to std conds			58.97	mg.m-3 (corrected)
Expanded uncertainty	**expressed with a level of confidence of 95%**		**4.21 % ELV**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**58.97 mg.m^{-3} of result**	

VOC - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.80
Standard deviation of repeatability at span level	u_{rs}	0.07
Lack of fit	u_{fit}	3.74
Drift	u_{0dr}	19.40
volume or pressure flow dependence	u_{spres}	0.00
atmopsheric pressure dependence	u_{apres}	7.48
ambient temperature dependence	u_{temp}	0.00
NH3 (20 mg/m3)	u_{interf}	0.00
CO2 (15%)	-	0.00
H2O (30%)	-	0.00
Error on Logger voltage	-	1.00
Dependence on voltage	u_{volt}	0.03
losses in the line (leak)	u_{leak}	20.09
Uncertainty of calibration gas	u_{calib}	20.09

VOC Measurement uncertainty		Result	1739.90	mg/m^3
Combined uncertainty			35.42	mg/m^3
Expanded uncertainty	k = 2		70.84	mg/m^3
Uncertainty corrected to std conds			81.80	mg.m-3 (corrected)
Expanded uncertainty	**expressed with a level of confidence of 95%**		**8.18 % ELV**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**81.80 $mg.m^{-3}$ of result**	

Oxygen - Measurement performance related to stationary conditions		
Performance characteristic	**Uncertainty**	**Value of uncertainty quantity**
Standard deviation of repeatability at zero	u_{r0}	0.20
Standard deviation of repeatability at span level	u_{rs}	0.02
Lack of fit	u_{fit}	0.08
Drift	u_{0dr}	0.10
volume or pressure flow dependence	u_{spres}	0.00
atmopsheric pressure dependence	u_{apres}	0.07
ambient temperature dependence	u_{temp}	0.07
CO2 (15%)	-	0.00
NO(300)	-	0.06
NO2(30)	-	0.00
dependence on voltage	u_{volt}	0.02
losses in the line (leak)	u_{leak}	0.08
Error in Logger voltage	-	0.03
Uncertainty of calibration gas	u_{calib}	0.08

O2 Measurement uncertainty		Result	7.04	%vol
Combined uncertainty			0.21	%vol
% of value			3.00	%
Expanded uncertainty	**expressed with a level of confidence of 95%**		**6.01 % of value**	
Expanded uncertainty	**expressed with a level of confidence of 95%**		**0.42 % vol**	

2.4 Appendix IV: Moisture Calculations

Test No	T1
Date	19-9-13
pbar (mbar)	988
pbar (mnHg)	741
nozzle diameter (mm)	n/a
Temp of Meter (in)/(out) deg. C	23
$\Delta H_{@}$ (mmH_2O)	10.0
DGM Cal Factor (Y)	0.9821

Site	Cory
	Hafod
Stack	Flare
Job Number:	R13156
Site Team:	BK & YS
Data Entered By:	BK

Enter Data into coloured cells only

End Volume Reading	451.43	m^3	end time	13:05	hr:min
Start Volume reading	450.84	m^3	start time	12:05	hr:min
Volume Sampled	0.583	m^3	total time	01:00	hr:min

IMPINGER	1	2	3	4	Analyst
Absorber Solution (Type):	H2O	H20	KO	SiGel	
Final Weight of Impingers plus absorber (g)	754.0	768.5	579.3	898.1	YS
Initial Weight of Impingers plus absorber (g)	733.3	767.6	579.1	892	YS
Weight Gain (g)	20.7	0.9	0.2	6.1	

Total Weight Gain (1+2+3+4) (g)	27.9

Gas Volume of water at 0 °C (l)	34.74
Gas Meter volume at 0 °C (l)	525.28

Moisture content of Gases (%)	6.2

Job Number: R13156

Client Name: Cory Environmental (Central) Ltd

envirodat

Test No	T2
Date	19-9-13
pbar (mbar)	988
pbar (mnHg)	741
nozzle diameter (mm)	n/a
Temp of Meter (in)/(out) deg. C	23
$\Delta H_{@}$ (mmH_2O)	10.0
DGM Cal Factor (Y)	0.9821

Site	Cory
	Hafod
Stack	Engine 923
Job Number:	R13156
Site Team:	BK & YS
Data Entered By:	BK

Enter Data into coloured cells only

End Volume Reading	452.05	m^3	end time	15:35	hr:min
Start Volume reading	451.43	m^3	start time	14:35	hr:min
Volume Sampled	0.608	m^3	total time	01:00	hr:min

IMPINGER	1	2	3	4	Analyst
Absorber Solution (Type):	H2O	H20	KO	SiGel	
Final Weight of Impingers plus absorber (g)	807.3	768.9	580.1	909.2	BK
Initial Weight of Impingers plus absorber (g)	754	768.5	579.3	898.1	BK
Weight Gain (g)	53.3	0.4	0.8	11.1	

Total Weight Gain (1+2+3+4) (g)	65.6

Gas Volume of water at 0 °C (l)	81.67
Gas Meter volume at 0 °C (l)	547.39

Moisture content of Gases (%)	13.0